UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No.:
2004/01612

February 16, 2005

Richard W. Hobernicht
Colonel, Corps of Engineers
Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Reinitiation of Endangered Species Act Section 7 Formal Consultation and Conference Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for the Columbia River Federal Navigation Channel Improvement Project

The enclosed document contains a biological and conference opinion (Opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) on the effects of Columbia River Federal Navigation Channel Improvements Project (Project). In this Opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Snake River sockeye salmon (*Oncorhynchus nerka*), Snake River fall Chinook salmon (*O. tshawytcha*), Snake River spring/summer Chinook salmon, Snake River Basin steelhead (*O. mykiss*), Upper Columbia River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead, Middle Columbia River steelhead, Columbia River chum salmon (*O. keta*), Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River spring run Chinook salmon, and Lower Columbia River coho salmon (*O. kisutch*) (proposed for listing) or result in the destruction or adverse modification of their proposed and designated critical habitat. In reaching this conclusion, NMFS relied on the best available scientific and commercial data.

The Opinion also includes an Incidental Take Statement with Terms and Conditions necessary to minimize the impact of taking that is reasonably likely to be caused by this action. Take from actions by the action agency and applicant, if any, which meet these terms and conditions, will be exempt from the ESA take prohibition.

This Opinion also includes the results of our consultation on the Project's likely effects on essential fish habitats (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects to EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the Corps of Engineers (Corps) must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations.

This new Opinion, which supercedes the May 20, 2002 Opinion for the Project, is based on a reinitation request from the Corps. On October 20, 2004, the Corps requested reinitiation of consultation on the Project to evaluate the Opinion in light of the recent Ninth Circuit Court of Appeals decision on critical habitat, *Gifford Pinchot Task Force, et al. v. U.S. Fish and Wildlife Service*, 378 F.3d 1059 (9th Cir. 2004). On October 28, 2004, NMFS agreed that while the 2002 Opinion properly analyzed the Project's impacts on the value of critical habitat for the recovery of the ESA-listed species, reinitiation of consultation was nonetheless warranted in light of the *Gifford Pinchot* decision.

We appreciate the continued close collaboration with your staff on this project. If you have questions regarding this consultation, please contact Ms. Cathy Tortorici, Chief, Oregon Coast/Lower Columbia River Branch, of the Oregon State Habitat Office in Portland, Oregon, at 503.231.6268.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Kemper McMaster, FWS

Endangered Species Act - Section 7 Consultation
Biological Opinion & Conference Opinion

and

Magnuson-Stevens Act
Essential Fish Habitat Consultation

Reinitiation of Columbia River Federal Navigation
Channel Improvements Project

Action Agency: U.S. Army Corps of Engineers - Portland District

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: February 16, 2005

Issued by: for Michael R Crouse
D. Robert Lohn
Regional Administrator

Refer to: **2004/01612**

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

1.1 Introduction

The Endangered Species Act (ESA) (16 U.S.C. 1531-1544), establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat upon which they depend. Section 7(a)(2) of the ESA requires that Federal agencies consult with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) to insure that any action funded, authorized or carried out by Federal agencies is not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their proposed and designated critical habitats.

1.2 Biological Opinion

On May 20, 2002, NMFS issued a biological opinion (Opinion) that was the product of a consultation pursuant to section 7(a)(2) of the ESA between NMFS and the U.S. Army Corps of Engineers (Corps) on the Columbia River Federal Navigation Channel Improvements Project (Project). The Corps issued a biological assessment (BA) for the Project, dated December 28, 2001, and amended that document in a letter dated April 15, 2002. The 2001 BA and amendment letter described the proposed action for the Project. These Corps documents are herein referred to as the 2001 BA.

On October 20, 2004, the Corps requested reinitiation of consultation on the Project to evaluate the Opinion in light of the recent Ninth Circuit Court of Appeals decision on critical habitat, *Gifford Pinchot Task Force, et al. v. U.S. Fish and Wildlife Service*, 378 F.3d 1059 (9th Cir. 2004). On October 28, 2004, NMFS agreed that while the 2002 Opinion properly analyzed the Project's impacts on the value of critical habitat for the recovery of the ESA-listed species, reinitiation of consultation was nonetheless warranted in light of the *Gifford Pinchot* decision; hence the development of the current Opinion.

This Opinion presents NMFS' review of the status of each evolutionarily significant unit (ESU)[1] considered in this consultation, the condition of proposed and designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 C.F.R. 402.14[g]).

The proposed action covered by this Opinion consists of improvements to the main Columbia River navigation channel, ecological restoration features in the Lower Columbia River, and other associated activities. The channel improvements include the deepening of the main navigation channel in the Lower Columbia River and improvements to ship turning basins. Construction and maintenance of seven ship berths in the Lower Columbia River are considered interrelated and/or interdependent actions. The other activities include an ecosystem restoration initiative, a monitoring and evaluation program, a research program, and an adaptive management process

[1] 'ESU' means an anadromous salmon or steelhead population that is either listed or being considered for listing under the ESA, is substantially isolated reproductively from conspecific populations, and represents an important component of the evolutionary legacy of the species (Waples 1991). An ESU may include portions or combinations of populations more commonly defined as stocks within or across regions.

governing the implementation of the proposed action. The purpose of the proposed action is to remove existing depth constraints to vessel movements and thereby improve access to the ports of the Lower Columbia River for deep draft vessels, and to restore ecological functions in the Lower Columbia River for ESA-listed salmonids and other fish and wildlife species.

The purpose of this consultation is to evaluate whether the proposed action will jeopardize the continued existence of ESA-listed salmonids or result in the destruction or adverse modification of proposed or designated critical habitat. The species considered in this consultation are listed in Table 1.1. The Corps indicated in their 2001 BA that the Project is likely to adversely affect ESA-listed salmonids, and not likely to adversely affect northern sea lions (Steller sea lions). NMFS concurs with the Corps determination for Steller sea lions.

Table 1.1 Listing Status, Biological Information, Critical Habitat Elements, and Protective Regulations for the ESA-listed and Proposed Species Considered in this Consultation ('T' = Threatened, 'E' = Endangered, and 'P' = Proposed)

Species ESU	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River	T 3/24/99; 64 FR 14308	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Upper Willamette River	T 3/24/99; 64 FR 14308	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Upper Columbia River spring-run	E 3/27/99; 64 FR 14308	P 12/14/2004; 69 FR 74572	ESA Section 9 applies
Snake River spring / summer run	T 4/22/92; 57 FR 14653	10/25/99; 64 FR 57399	7/10/00; 65 FR 42422
Snake River fall-run	T 6/3/92; 57 FR 23458	12/28/93; 58 FR 68543	7/10/00; 65 FR 42422
Chum salmon (*O. keta*)			
Columbia River	T 3/25/99; 64 FR 14508	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Coho salmon (*O. kisutch*)			
Lower Columbia River	P 6/14/04; 69 FR 33102	Not applicable	Not applicable
Sockeye salmon (*O. nerka*)			
Snake River	E 11/20/91; 56 FR 58619	12/28/93; 58 FR 68543	ESA Section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River	T 3/19/98; 63 FR 13347	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Upper Willamette River	T 3/25/99; 64 FR 14517	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Middle Columbia River	T 3/25/99; 64 FR 14517	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Upper Columbia River	E 8/18/97; 62 FR 43937	P 12/14/2004; 69 FR 74572	ESA Section 9 applies
Snake River Basin	T 8/18/97; 62 FR 43937	P 12/14/2004; 69 FR 74572	7/10/00; 65 FR 42422
Steller Sea Lion (Northern Sea Lion)	T 11/26/90; 55 FR 49204	8/27/93; 50 FR 45296	January 8, 2002;67 FR 956; amended & corrected; May 1, 2002; 67 FR 21600

1.3 Relationship to Other Biological Opinions

NMFS previously consulted with the Corps on the maintenance dredging activities in the Columbia River. These biological opinions demonstrate NMFS' involvement and understanding of Columbia River dredging issues, and serve as a record of issues that we have raised during consultations on previous dredging actions.

The consultations previously conducted on the Corps' Operation and Maintenance Dredging activities include:

- An August 1, 1991, informal consultation for use of Interim Area D Estuarine Disposal Site in Clatsop County, Oregon;
- A February 25, 1992, informal consultation for construction of the Wahkiakum Ferry Channel at Puget Island, Washington;
- A March 5, 1992, informal consultation for emergency dredging sites in the Columbia River;
- A December 11, 1992, informal consultation for expansion of Columbia River dredged material disposal sites;
- A November 5, 1993, informal consultation for Dungeness crab entrainment studies in Baker Bay, Washington;
- A December 22, 1993, formal consultation on Columbia River operation and maintenance dredging;
- A September 14, 1994, reinitiation of the December 22, 1993 formal consultation to address designated critical habitat;
- An April 6, 1996, informal consultation on hopper and pipeline dredging in the Columbia River;
- A September 22, 1995, formal consultation on repair of pile dikes in the Lower Columbia River;
- A July 25, 1996, reinitiation of the September 22 formal consultation to address additional pile dikes;
- An August 2, 1996, informal consultation on replacement of a navigational aid in the Lower Columbia River;
- A May 28, 1998, informal consultation for the maintenance dredging program to address listing of Snake River and Upper Columbia River steelhead;
- A May 27,1999, informal consultation to begin dredging operations at the mouth of the Columbia River; and
- A September 15, 1999, formal consultation on operation and maintenance dredging from John Day Dam to the mouth of the Columbia River.

NMFS also previously completed a December 16, 1999, biological opinion on the Corps' proposed channel deepening project, which NMFS subsequently withdrew. That led to reinitiation of consultation on the revised Project, resulting in the May 20, 2002, biological opinion. This current Opinion supercedes our May 20, 2002, biological opinion. Further background on the earlier consultations associated with this Project is described in section 2.2 of this Opinion.

In November 2004, NMFS issued a biological opinion on the Corps' operation of the Federal Columbia River Hydropower System (FCRPS) that addressed that project's impacts to the primary limiting factors of flow, waterborne toxics, and habitat on ocean-type ESU viability (*i.e.*, Columbia River chum and Snake River Fall Chinook). This Opinion for the Columbia River Channel Improvements Project is consistent with the findings of the 2004 FCRPS Hydropower Biological Opinion.

1.3.1 Jeopardy and Adverse Modification Determination

NMFS determines whether the species can be expected to survive, under the effects of the proposed action, environmental baseline and cumulative effects; and whether the action will appreciably diminish the value of critical habitat for the survival or recovery of the species. For the jeopardy analysis, NMFS considers those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESA-listed species. In critical habitat analysis, NMFS determines whether the proposed action will destroy or adversely modify proposed or designated critical habitat for ESA-listed species by examining any change in the conservation value of the essential features of critical habitat. This analysis does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02, recently at issue in the *Gifford Pinchot* case. Instead, it focuses on the effects of the proposed action on critical habitat and on the role that proposed and designated critical habitat must play with respect to the recovery of each ESA-listed ESU. The analysis focuses on statutory provisions of the ESA, including those in Section 3 that define 'critical habitat' and 'conservation,' in Section 4 that describe the designation process, and in Section 7 setting forth the substantive protections and procedural aspects of consultation.

If the action under consultation is likely to jeopardize the continued existence of an ESA-listed species, or destroy or adversely modify proposed or designated critical habitat, NMFS must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of proposed or designated critical habitat and meet other regulatory requirements (50 C.F.R. 402.02).

2. BACKGROUND

2.1 Introduction to the Columbia River Channel Improvements Project

The Corps maintains the Federal Navigation Channel in the Columbia River through operation and maintenance dredging. Currently, the navigation channel is maintained at an average depth of 40 feet in depth including advanced maintenance dredging up to 100 feet over-width and 5 feet over-depth.

The Columbia River Channel Improvements Project (Project) includes two distinct types of activities: (1) Deepening of the navigation channel, which includes turning basin improvements and berths that are interrelated and/or interdependent to the Project; and (2) ecosystem restoration. Associated with the navigation channel improvements and ecosystem restoration and research activities are compliance, monitoring, and adaptive management actions.

Navigation channel improvements will require two main actions: dredging and disposal of dredged materials. Dredging and disposal will occur in two stages: an initial construction program to deepen the existing navigation channel, and a subsequent program to maintain the deepened navigation channel. The construction phase will last two years, and the maintenance phase will last the remainder of the authorized 50-year economic life of the Project (section 3.2 of this Opinion). The Project will continue beyond 50 years unless un-authorized by Congress.

2.2 Consultation History

The reinitiation of consultation by the Corps and NMFS of the May 2002, Opinion resulted in this current Opinion. The reinitiation of consultation by the Corps and NMFS on the December 1999, Opinion resulted in the May 2002, Opinion. Below is a brief synopsis of the history of the first and second phases of the 2001 to 2002 comprehensive re-evaluation process. A more complete description can be found in section 1.3 of the 2001 BA.

<u>First Phase</u>
In its April 5, 1999, BA, the Corps requested formal consultation for the proposed Project. NMFS worked with the Corps for several months to identify further information regarding the anticipated effects of the proposed action on ESA-listed salmonids. On August 25, 1999, upon receipt of the Final Environmental Impact Statement (FEIS), NMFS determined there was sufficient information to initiate formal consultation. On December 3, 1999, the Corps amended its proposed action and BA to include additional conservation actions, including research, ecological restoration, and monitoring. On December 16, 1999, NMFS issued a biological opinion for the proposed Project. The biological opinion determined that, based on the conservation measures proposed, the Project would not jeopardize the continued existence of ESA-listed salmonids found in the action area or adversely modify their proposed and designated critical habitat.

<u>Second Phase</u>
On August 25, 2000, NMFS officially withdrew the December 16, 1999, biological opinion and requested reinitiation of consultation (*see* Appendix A of the 2001 BA for withdrawal letter). NMFS requested reinitiation of consultation to fully assess the implications of new information associated with the Project impacts, to reach agreement on the specific studies and monitoring to be undertaken, to clarify the commitments and schedules for undertaking the restoration work, and to make any necessary refinements to the conservation measures associated with the proposed action. NMFS, FWS, the Corps, agreed the Corps should prepare a new BA (2001 BA) and re-evaluate the Project's effects on ESA-listed salmonids.

The objective of the 2001 to 2002 comprehensive re-evaluation was to improve the scientific understanding of the effects of the Project and to reduce the uncertainties associated with these evaluations through the use of multiple complementary modeling efforts and independent scientific review. The reinitiation of consultation resulted in a re-evaluation of ESA-listed salmonid issues by an independent, scientific panel; a series of five technical panel discussions open to the public; and a multi-agency Biological Review Team (BRT). These efforts resulted in the development and use of new analytical tools, including two numerical models and an ecosystem-based conceptual ecosystem model. During the reinitiation process, the Corps, NMFS, FWS, and the Ports participated in a mutual analysis of Project effects, and subsequently identified modifications to the Project to minimize or avoid potential Project effects. To provide further assurances that the Project would be successful in minimizing or avoiding adverse effects to ESA-listed salmonids, NMFS, and the Corps developed monitoring activities and adaptive management requirements that have been incorporated into the proposed action for the Project.

Finally, during this deliberative process, FWS and NMFS recommended ecosystem research to fulfill the Corps' responsibilities under Section 7(a)(1) of the ESA. The Corps, FWS, and the

Ports also identified additional ecosystem restoration features to fulfill the Corps' responsibilities under Section 7(a)(1) of the ESA, which were included in the proposed action for the Project. NMFS reviewed those ecosystem restoration features during the development of the 2001 BA.

3. PROPOSED ACTION

3.1 Introduction

Subsequent to NMFS' August 25, 2000, withdrawal of its December 1999 biological opinion, the Corps, sponsoring Ports, NMFS, and FWS developed a 'reinitiation framework' to address NMFS' major concerns and to re-define, as necessary, the proposed action. Several steps were involved in the development of the current proposed action, including a re-evaluation of potential Project effects, an analysis of these potential effects within the framework of an ecosystem-based conceptual ecosystem model, and the development of compliance measures and monitoring conditions based on the effects analyses. As part of the reinitiation process, the Corps, NMFS, FWS, and the Ports identified additional monitoring, research, and adaptive management components of the proposed action. The Corps, FWS, and the Ports also identified additional ecosystem restoration features to be included in the proposed action for the Project. NMFS reviewed those ecosystem restoration features as part of the development of the 2001 BA (section 1.3.2). The Corps' 2001 BA fully describes this reinitiation process, and those descriptions are incorporated herein by reference. The following is a brief overview of the steps that led to the current proposed action.

To facilitate discussion of the scientific questions raised by NMFS in their August 25, 2000, withdrawal letter, the Corps, NMFS, FWS, and the Ports retained Sustainable Ecosystems Institute (SEI), a public-benefit, science mediation group. Through a panel of seven nationally-prominent technical experts, SEI provided an independent, scientific process to evaluate the potential environmental issues surrounding improvement of the navigation channel. A series of SEI workshops helped frame major concerns raised in connection with the proposed Project and identify best available science for additional analysis of Project effects.

Beginning in early spring 2001, the Corps, NMFS, FWS, and the Ports formed a technical group called the BRT. The BRT engaged in regular meetings to further review and address technical issues associated with the proposed Project and its potential effects. These BRT technical meetings occurred during and after the SEI workshops, and the results were incorporated into the SEI workshop proceedings.

During the SEI workshop process, a conceptual ecosystem model was designed to provide an integrated description of the major ecosystem links that affect ecosystem structure and function as they relate to juvenile salmonid production and ocean entry (Chapter 5 of the 2001 BA). The specific objectives of the model were to:

- Provide an ecosystem-level scientific framework for evaluating the Project.
- Identify links among physical-chemical and biological indicators.
- Aid in the identification of ecosystem-based processes that link salmon and potential effects of the Project.

- Develop a systematic methodology to evaluate monitoring and adaptive management opportunities.

The conceptual ecosystem model describes the physical and biological interactions of the Lower Columbia River (from Bonneville Dam downstream to the upper end of the estuary at RM 40, estuary (RM 40 to RM 3), and river mouth (RM3 to deep water disposal site)) in a manner that helps to characterize properly functioning conditions for the system. The model was used by the BRT as an analytical tool for Project effects analyses. The Corps also conducted additional numerical modeling of hydraulic parameters (*i.e.*, salinity, velocity, depth, and temperature) for the Lower Columbia River, estuary and river mouth. Modeling analysis was conducted by both the Oregon Health and Science University/Oregon Graduate Institute (OHSU/OGI) and the Corps' Waterways Experiment Station (WES). The OHSU/OGI modeling was conducted to verify the previous conclusion of the WES modeling from the Corps' 1999 FEIS and provide additional analyses on potential Project effects to habitat opportunity[2] for juvenile salmonids (Bottom *et al.*, 2001).

Ultimately, the Corps, NMFS, FWS, and Ports reviewed each aspect of the original 1999 proposed action, and using the best available science, including the SEI workshops, the numeric and conceptual ecosystem model, and the results of the BRT meetings, agreed upon the current proposed action for dredging and disposal activities. The BRT identified additional compliance measures and monitoring conditions in order to minimize or avoid Project effects. Finally, the BRT proposed an adaptive management process to review information from the compliance and monitoring activities and make necessary Project modifications to minimize and avoid impacts.

3.2 Description of the Proposed Action

The proposed action consists of several components that have been developed over the course of this consultation. They include:

- Construction of the deeper navigation channel, employing a range of best management practices (BMPs) to avoid or minimize harm to ESA-listed salmonids.
- Maintenance dredging to maintain navigation depths for the navigation channel and other associated features.
- Disposal of construction and maintenance dredged materials in suitable locations to avoid or minimize adverse effects on ESA-listed salmonids and, where appropriate, improve ecological functions in the near shore area.
- Design and implementation of a robust monitoring program to evaluate implementation performance and ecological responses.
- Implementation of an adaptive management process to respond to future adverse effects.
- Implementation of ecosystem restoration efforts to improve ecological functions of significance to ESA-listed salmonids in the Lower Columbia River and estuary.

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[2] Habitat opportunity, as discussed in *Salmon at River's End* (Bottom, *et al*., 2001), refers to those physical characteristics that affect access to geographical locations that are important to particular fish needs.

- Undertaking an ecological research program to further reduce uncertainties over the life of the Project.

Each of these elements of the proposed action are summarized below. A more complete description of them is in the 2001 BA (sections 3, 8, and 9) and are incorporated herein by reference.

The proposed action can be categorized into two distinct types of activities: Deepening of the navigation channel (includes turning basins and berths that are interrelated and/or interdependent to the Project); and ecosystem restoration and research. Associated with the navigation channel improvements and ecosystem restoration and research activities are compliance, monitoring, and adaptive management actions.

Navigation channel improvements will require two main actions: Dredging and disposal of dredged materials. Dredging and disposal of dredged materials will occur in two stages: An initial construction program to deepen the existing navigation channel, turning basins, and berths that are interrelated and/or interdependent to the Project, and a subsequent program to maintain the deepened navigation channel, berths, and turning basins. The construction phase will last two years, and the maintenance phase will last the remainder of the authorized Project life. Project actions specific to dredging and disposal are described below.

Deepening of the Lower Willamette River, which had been a component of the authorized Project and discussed in the 1999 FEIS, is not reasonably certain to occur. Portions of the lower Willamette River have been designated as a Federal National Priorities List site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Construction of the Project's Lower Willamette River features has been deferred pending study and selection of an appropriate remedy for cleanup under CERCLA. Because the lower Willamette deepening is not reasonably certain to occur, this potential future Federal action is not addressed in this Opinion.

Construction and maintenance dredging at Lower Columbia River berths associated with three grain facilities, one gypsum plant, and one container terminal, represent actions that are interrelated and/or interdependent to the Project. Therefore, this Opinion considers the effects to ESA-listed salmonids and their proposed and designated critical habitat from these berth deepening and maintenance activities. However, this Opinion does not provide incidental take coverage for berth dredging, as these activities will undergo future ESA consultation. The future ESA consultation will initiate upon NMFS' receipt of applications for Federal permits, before berth dredging activities occur.

The Corps proposes to increase the depth of the Columbia River navigation channel, from its presently authorized -40 Columbia River Datum (CRD) feet, to -43 CRD feet. "Advanced maintenance" dredging will occur during the Project's construction and maintenance components, including advanced maintenance dredging for up to 100 feet over width and 5 feet over depth for a maximum constructed navigation channel depth of 48 feet. This is a standard practice for operation and maintenance of the 40-foot channel and is used to insure a safe operational depth between operation and maintenance dredging periods. The current navigation channel's 600-foot width will be maintained, with additional channel width at channel turns and areas of high-reoccurrence of shoaling. The improved navigation channel will exist in the same location as the current -40 foot navigation channel. In addition, a total of three existing turning basins would be deepened to -43 CRD feet and maintained as part of the proposed action. Currently existing Lower Columbia River berths at three grain facilities, one gypsum plant, and one container terminal, which are interrelated and/or interdependent to the Project, will be deepened to -43 CRD feet and maintained.

The Corps proposes to deepen the navigation channel, from RM 3 to RM 106.5 on the Columbia River (section 1.2 and Figure 1-1 of the 2001 BA). An estimated total of 19 million cubic yards (mcy) of sand, 76,000 cubic yards (cy) of basalt rock, and 240,000 cy of cemented sand, gravel, and boulders would be initially removed from the navigation channel using hopper, clamshell, and pipeline dredges. Once the improvements are completed, the channel will require annual maintenance dredging. Over the initial 20 years, annual maintenance dredging is expected to decline from around 8 mcy to about 3 mcy of sand annually as the new channel reaches equilibrium. Annual maintenance will then continue at an average of about 3 mcy of sand per year for the succeeding 30 years. This amounts to a total Project dredging quantity of about 190 mcy for the Project. During this same 50-year period without the 43-foot project, approximately 160 mcy would be dredged to maintain the 40-foot channel.

The Corps is proposing to employ contractors, Federal and Port personnel, vessels, and equipment to implement the Project's dredging and disposal activities. Channel construction and maintenance will encompass a variety of dredging and dredged material disposal methods, as well as associated impact minimization measures. NMFS has reviewed each portion of the action to develop additional impact minimization and BMPs, which the Corps has incorporated as a component of the proposed action. The following is a general discussion of the pre-Project planning, dredging and disposal methods, locations, and impact minimization measures.

3.2.1 Navigation Channel Shoals that are Less than 48 Feet Deep

Construction and maintenance dredging activities will mainly focus on navigation channel shoals that are less than 48 feet deep. These channel features will be surveyed before construction and maintenance dredging activities, and dredging activities will be localized and limited to these shallow shoal features.

3.2.2 Construction and Maintenance Dredging

Once the planning actions are complete, the following BMPs, including Project compliance activities, will apply to Project construction and maintenance dredging (Table 3.1). These BMPs for the dredging actions are designed to avoid or minimize potential for adverse effects upon ESA-listed salmonids and their designated and proposed critical habitat. Construction and maintenance dredging BMPs will remain in effect during the life of the Project, or until new information becomes available that would warrant change (section 3.1.6, below). Contractors or other construction and maintenance workers will employ the following methods described in Table 3.1, as appropriate, to most efficiently complete the construction and maintenance dredging activities. Contractors and other workers will be required to conduct dredging activities in compliance with the proposed action, including full implementation of BMPs, compliance monitoring, and reporting. Section 7.3 of the 2001 BA contains a more complete description of the compliance monitoring program. It is incorporated herein by reference.

Table 3.1 Dredging Methods, Descriptions, and Associated BMPs

Dredging Method	Description (also refer to 2001 BA)	Best Management Practices
Hopper	Use dual dragarms to lower dragheads onto substrate. Riverbed materials are removed via suction to transport materials into the hold of the vessel. Generally used for small sand shoals in river and large sand shoals in estuary.	-Minimize entrainment by maintaining, to the extent possible, the draghead below substrate. Pumping must stop if draghead is raised more than 3 feet above substrate. -Minimize turbidity by maintaining, to the extent possible, the draghead below substrate. -Contracts will specify compliance plans
Mechanical	Use bucket to remove materials and transfer to a barge for transport. Includes clamshell, dragline, and backhoe dredges. Mainly used during construction phase for removal of cemented sands, gravels, and fractured rock. Limited maintenance application, mainly in confined areas.	-Contractors will specify compliance plans -Future berth deepening and maintenance will occur within timing window of November 1-February 28
Pipeline	Use cutterhead on end of long pipe to remove sediments. Riverbed materials are removed via suction to a floating pipeline. The pipeline delivers the riverbed materials to the disposal location.	-Minimize entrainment by maintaining, to the extent possible, the cutterhead below substrate. Pumping must stop if cutterhead is raised more than 3 feet above substrate. -Minimize turbidity by maintaining, to the extent possible, the cutterhead below substrate. -Contractors will specify compliance plans
Drilling and Blasting	Associated with channel construction at basalt rock outcrops. Holes would be drilled in underwater rock formation, and charges set to create an implosion.	-A blasting plan would be developed for each site. -Implosion rather than explosion. -Over-pressure from blast less than ten psi. -Monitoring of blasts. -Fish "hazing" employed before blast. -Timing window of November 1-February 28.

Project construction dredging, using any of the aforementioned dredging methodologies, may occur year-round until the navigation channel and turning basin deepening is complete. Future berth deepening will occur within a timing window of November 1 to February 28. Another exception to the aforementioned in-water work window 'waiver' is removal of rocks via blasting. Any rock blasting will occur within an in-water timing requirement of November 1 to February 28.

Project maintenance dredging for navigation channel or turning basin features will not have any in-water timing restrictions. However, the Corps has traditionally implemented navigation channel maintenance dredging from May through October, and anticipates Project maintenance dredging to occur during May 1 to October 31, annually. Future berth maintenance dredging will occur within a timing window of November 1 to February 28.

3.2.3 Construction and Maintenance Disposal Activities

Dredged materials from Project construction and maintenance will be disposed of in upland, flowlane, shoreline, mitigation sites, and one ocean disposal location. Most of the Project's dredged material will be disposed of in upland locations. All dredged materials destined for flowlane, shoreline or ocean disposal will not exceed thresholds for sediment composition and quality, as identified in the Corps' and Environmental Protection Agency's Dredged Materials Evaluation Framework (DMEF). Table 3.2 outlines the various disposal options and volumes of dredged material.

Disposal options and the associated material volume for the first 20 years include: 29 upland locations covering 1,755 acres (71 mcy); ocean (16 mcy); and one mitigation site (1 mcy). The Corps' has also finalized a disposal plan for the Project via their final supplemental integrated feasibility report/EIS. Regarding ocean disposal, NMFS' January 6, 2005 letter of concurrence on the de-designation and designation of ocean dumping sites offshore the mouth of the Columbia River concluded that EPA's designation of the ocean deep water site was not likely to adversely affect the ESA-listed species.

The following methods, and associated BMPs, will be used for dredged material disposal (Table 3.2). These BMPs, which will be included in the final disposal plan, will avoid or minimize impacts to ESA-listed salmonid species and their designated and proposed critical habitat. Material disposal BMPs will remain in effect throughout the Project, or until new information becomes available that would warrant change (section 3.2.6, below).

Table 3.2 Disposal Methods, Descriptions, and Associated BMPs

Disposal Method	Description (also refer to BA)	Best Management Practices
Upland	Materials pumped via slurry pipeline or hauled to upland site. Materials permanently held at upland site via earthen dikes. Any shoreline site associated with upland disposal will be restored.	-Upland sites bermed to maximize settling of fine materials. -New upland sites a minimum of 300 feet from shoreline or other aquatic habitat feature. Existing sites may not have this habitat buffer, but currently provide limited habitat value. -Riparian vegetation will be protected. -Vegetative restoration will occur.
Flowlane	Either hopper or pipeline methods will use flowlane disposal. Dredged materials will be released into deep water sites within or beside navigation channel.	-Maintain discharge pipe of pipeline dredge at depths greater than 20 feet. -Dispose of material in a manner that prevents in-water mounding.
Shoreline	Pipeline method primarily used for shoreline disposal. A sand and water slurry is pumped onto an existing beach or shoreline landing, and the beach is extended approximately 100-150 feet into and for varying distances along the river channel. Shoreline disposal occurs concurrently with dredging; timing restrictions therefore based on dredging methodology.	-Contour new beach to minimum steepness of 10-15% slope, to prevent fish stranding. -Only highly-erosive, and therefore lower habitat quality, shoreline sites will be used.
Ocean	A single, 200-300 foot deep ocean location, approximately 4.5 miles west of the Columbia River mouth, will be used for ocean disposal. Hopper dredges will release dredged materials in an 11,000 by 17,000 foot area.	-No ESA BMPs. -Dispose of material in accordance with the site monitoring and management plan which calls for a point dump placement of material from the Project during construction. The plan is to place any construction material in the southwest corner of the deep water ocean site.

Project disposal activities will not have any in-water timing restrictions. However, as disposal occurs at the same time as dredging activities, dredged material disposal associated with construction dredging will occur year round, whereas disposal associated with maintenance dredging will most likely occur from May through October.

3.2.4 Additional Provisions for Protection of Water Resources

Additional provisions regarding release of trash, garbage, hazardous waste, or other contaminants will be implemented during dredging and disposal activities (Table 3.3).

Table 3.3 Additional Provisions for Protection of Water Resources

General Measure	Action
The contractor shall not release any trash, garbage, oil, grease, chemicals, or other contaminants into the waterway.	-If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. -Contaminated ground shall be excavated and removed and the area restored as directed. -Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.
The contractor, where possible, will use or propose for use, materials that may be considered environmentally-friendly in that waste from such materials is not regulated as a hazardous waste or is not considered harmful to the environment. If hazardous wastes are generated, disposal of this material shall be done in accordance with 40 C.F.R. parts 260-272 and 49 C.F.R. parts 100-177.	-If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. -Contaminated ground shall be excavated and removed and the area restored as directed. -Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.

3.2.5 Locations for Construction and Maintenance Dredging and Dredged Material Disposal

Construction and maintenance dredging and dredged material disposal locations are identified by river reach in the following table (Table 3.4). Dredged material removed from a reach of the river could be disposed in a location in a different reach of the river. The table is only intended to display the dredging location and disposal location within a given reach, not to imply material movement from one location to another. Unrestrained open water (flow lane) disposal of suitable dredged materials may occur anywhere in or immediately beside the navigation channel, and at any time in the Project area, RM 3-106.5.

Table 3.4 Proposed Dredging Locations, Disposal Locations, and Types of Disposal

River Reach	Dredge Locations	Disposal Locations, Type (U=upland, F=flowlane, S=shoreline, I=in-water)
Reach 1 RM 98-106.5	Lower Vancouver Bar (RM 101.3-104.6) Morgan Bar (RM 97.8-101.3) Vancouver Turning Basin (RM 105.5) Terminal 6 Berths (3 berths) (RM 100-101) United Harvest Berth (RM 105.2)	West Hayden Island (RM 105.0) **U** Gateway 3 (RM 101.0) **U** Entire Reach **F**
Reach 2 RM 84-98	Willow Bar (RM 93-9-97.8) Henrici Bar (RM 90.4-94.9) Warrior Rock Bar (RM 87.3-90.4) St. Helens Bar (RM 83.3-87.3)	Fazio Sand & Gravel (RM 96.9) **U** Adjacent Fazio (RM 96.9) **U** Lonestar (RM 91.5) **U** Railroad Corridor (RM 87.8) **U** Austin Point (RM 86.5) **U** Sand Island (RM 86.2) **S** Entire Reach **F**
Reach 3 RM 70-84	Upper Martin Island Bar (RM 80.3-83.8) Lower Martin Island Bar (RM 76.5-80.3) Kalama Ranges (RM 72.8-76.5) Upper Dobelbower Bar (RM 69.9-72.8) Kalama Export Grain Berth (RM 77.1) Port-of-Kalama Berth (RM 73.4) Kalama Turning Basin (RM 73.5)	Reichold (RM 82.6) **U** Martin Bar (RM 82.0) **U** Lower Deer Island (RM 77.0) **U** Sandy Island (RM 75.8) **U** Northport (RM 71.9) **U** Cottonwood Island (RM 70.1) **U** Entire Reach **F**
Reach 4 RM 56-70	Lower Dobelbower Bar (RM 67.1-69.9) Slaughters Bar (RM 63.2-67.1) Walker Island Reach (RM 59.4-63.2) Stella-Fisher Bar (RM 55.6-59.4) U.S. Gypsum Berth (RM 65.7)	Howard Island (RM 68.7) **U** International (RM 67.5) **U** Rainier Beach (RM 67.0) **U** Rainier Industrial (RM 64.8) **U** Lord Island (RM 63.5) **U** Reynolds Aluminum (RM 63.5) **U** Mt. Solo (RM 63.5) **U** Hump Island (RM 59.7) **U** Crims Island (RM 57.0) **U** Entire Reach **F**
Reach 5 RM 40-56	Gull Island Bar (RM 51.9-55.6) Eureka Bar (RM 48.2-51.9) Westport Bar (RM 44.5-48.2) Wauna and Driscoll Ranges (RM 40.8-44.5)	Port Westward (RM 54.0) **U** Brown Island (RM 46.3) **U** Puget Island (RM 44.0) **U** James River (RM 42.9) **U** Entire Reach **F**
Reach 6 RM 29-40	Puget Island Bar (RM 36.6-40.8) Skamokawa Bar (RM 32.6-36.6) Brookfield-Welch Island Bar (RM 28.8-32.6)	Tenasillahe Island (RM 38.3) **U** Welch Island (RM 34.0) **U** Skamokawa (RM 33.4) **S** Entire Reach **F**

River Reach	Dredge Locations	Disposal Locations, Type (U=upland, F=flowlane, S=shoreline, I=in-water)
Reach 7 RM 3-29	Pillar Rock Ranges (RM 25.2-28.8) Miller Sands Channel (RM 21.4-25.2) Tongue Point Crossing (RM 17.5-21.4) Upper Sands (RM 13.6-17.5) Flavel Bar (RM 10.0-13.6) Upper Desdemona Shoal (RM 4.4-10.0) Lower Desdemona Shoal (RM 3.0-4.4) Astoria Turning Basin (RM 13)	Pillar Rock Island (RM 27.2) **U** Miller Sands (RM 23.5) **S** Rice Island (RM 21.0) **U** Entire Reach **F**
River Mouth RM 3-ocean	None	"Point dump" placement within southwest corner of deep water ocean site

3.2.6 Monitoring Program and Adaptive Management Process

As part of the Project, the Corps will implement a monitoring program. Monitoring actions were identified during the BRT's review and analysis of Project-related, short- and long-term, direct and indirect effects; discussions of relative risk of Project effects; and the certainty surrounding data used to determine risk. These monitoring activities will generate information and evaluate predicted effects to ESA-listed salmonids, validate assumptions used in the 2001 BA's effects analysis, and reduce overall risk and uncertainty associated with implementation of the Project.

Table 3.5 provides a brief overview of the proposed monitoring program. The entire description of the monitoring program included in Chapter 7, Table 7-3 of the 2001 BA, is incorporated by reference into this Opinion. Compliance monitoring will also occur during dredging and disposal activities for both construction and maintenance periods. Compliance monitoring was previously described in section 3.2.2, above.

Table 3.5 Key Components of Monitoring Program

Monitoring Task	NMFS and FWS' Concerns	Data Analysis	Duration	Management Trigger Points
Maintain three hydraulic monitoring stations: One downstream from Astoria, one in Grays Bay, and one in Cathlamet Bay. Parameters measured would include salinity, water surface elevation, and water temperature.	Long-term physical parameter changes related to Project.	An analysis would be conducted to determine pre- and post-Project relationships among flow, tide, salinity, water surface, and temperature.	7 years: 2 years before, 2 years during, and 3 years after construction.	Post-Project monitoring data exceeds defined threshold values (to be developed by adaptive management team).
Monitor annual dredging volumes; both from construction and O&M activities.	Dredging volumes may be larger than predicted.	Actual volumes will be compared to predicted.	Life of the Project.	Actual dredging volumes exceed capacity of the disposal plan.
Conduct main channel bathymetric surveys throughout Project area.	Side-slope adjustments may occur in other locations, and within sensitive aquatic habitats, than predicted.	Bathymetric changes will be tracked to determine if habitat is altered.	7 years: 2 years before, 2 years during, and 3 years after construction	Salmonid habitat alteration beside the navigation channel due to side-slope adjustment.
Repeat estuary habitat surveys being conducted by NMFS.	Long-term macro- and micro-habitat changes related to Project	Habitat mapping from aerial photos and ground surveys.	One time survey conducted 3 years after completion of the deepening.	Changes to individual habitat types that are based on defined threshold values. Determine need for other surveys.
The Corps, NMFS, and Service will meet annually, or as new circumstances arise, to review new sediment chemistry data from the Lower Columbia River and estuary. If these data exceed DMEF or NMFS contaminants guidelines for salmonid protection, or if other events such as changes in guidelines or threshold values occur, additional sediment and contaminant sampling would be initiated in accordance with the DMEF manual.	Ensure that channel construction and maintenance does not disturb undetected deposits of fine-grained material, potentially causing redistribution of contaminants that could pose a risk to salmon and trout.	New Corps sediment data, collected in response to the annual MA-5 monitoring action, will be reviewed in accordance with the DMEF manual and will be compared to the NMFS contaminants guidelines for the protection of salmon and trout.	Two years before construction, two years during construction, and annually during maintenance activities.	Any excedance of NMFS or DMEF guidelines will be reported to the adaptive management team to determine if consultation should be reinitiated.

Monitoring Task	NMFS and FWS' Concerns	Data Analysis	Duration	Management Trigger Points
Monitor the incidence of stranding of juvenile salmon on beaches in action area. Field surveys will be made monthly at selected beaches (upper, mid, and lower river) during the April-August out-migration to measure the number of fish being stranded along beaches.	Concern that disposal sites and ship traffic may allow for juvenile salmonid stranding.	Compare pre- and post-Project stranding counts.	One year before deepening and 1 year after deepening.	If there is an increase in the number of fish stranded, proposals would be developed and presented to adaptive management team.

An essential component of the monitoring program as described in Table 3.5 is the ongoing sampling of bottom sediments and testing for contaminants. For this Project, the Corps will use the 1998 regional Dredged Material Evaluation Framework (DMEF) protocols governing testing and evaluation of sediment to be dredged. The DMEF establishes minimum guidelines for testing and evaluation. The DMEF guidelines require the use of available sediment and contaminants information to make a preliminary determination concerning the need for testing of material proposed for dredging. Where available information suggests additional testing is required, sediments will be collected and analyzed before dredging and disposal. Otherwise, DMEF minimum sampling guidelines require periodic testing of sediments for long-term activities.

The Corps' analysis of available Lower Columbia River and estuary information revealed few samples with fine materials and no samples with contaminant concentrations that exceed the regional DMEF guidelines or NMFS sediment contaminant guidelines that are protective of ESA-listed salmonids. The Corps will test channel sediments in accordance with the DMEF guidelines, at a minimum of every 10 years in the main channel for sandy areas, every seven years for fine grained areas with no history of contamination, and every seven years where there is reason to believe contaminants may be present (Table 3.6). As noted in the 2001 BA Table 7-3, Monitoring Action MA 5, all information collected during these sediment and contaminant reviews, as well as sediment data from other sources, will be reported to the adaptive management team.

Table 3.6 Sediment Testing Locations and Minimum Frequency for New Sediment Sampling

Dredging Location	Frequency of Sampling (Yrs)
Main Channel RM 3-106.5	10
Turning Basins	
Astoria Turning Basin (RM 13)	7
Kalama Turning Basin (RM 73.5)	10
Vancouver Turning Basin (RM 105.5)	10
Berths	
United Harvest at Port of Vancouver (RM 104.2)	10
Harvest States at Port of Kalama (RM 77.1)	10
Peavy Grain at Port of Kalama (RM 73.4)	10
Terminal 6 at Port of Portland	7
U.S. Gypsum at Port of Rainier (RM 65.3)	10

The Corps also proposed an Adaptive Management Process. The 2001 BA (section 9.4) indicates that "actions associated with dredging and disposal, and ecosystem restoration and research will be coordinated through the adaptive management process to ensure that the Project will not jeopardize listed or proposed species or destroy or adversely modify their critical habitat." The proposed adaptive management process involves review and management response to two types of Project monitoring data: (1) Constant monitoring of Project effects during construction and maintenance activities (compliance monitoring); and (2) annual review of monitoring data or other new information. In addition to annual reviews, any adverse finding from compliance monitoring would be addressed immediately by the adaptive management team. The proposed adaptive management review and response will ensure unanticipated Project effects are rapidly identified and effectively addressed. Finally, adaptive management will be used to evaluate whether the Project's environmental protection objectives are being met, and to ensure construction and/or maintenance actions are adjusted accordingly.

The Corps' proposed adaptive management process requires the establishment of an identified scope including goals, milestones for completion, check-in points, triggers for management changes (*i.e.*, management decision points that include specific metrics), and sampling/testing protocols. The Corps will work with the Services to refine and develop the scope of the adaptive management process. However, the following specific adaptive management actions are identified in the 2001 BA (section 9.0):

- An adaptive management team, comprised of representatives from NMFS, FWS, Corps, and sponsor Ports, will annually review results of Project compliance measures, monitoring, research, and restoration actions. On an annual basis the adaptive management team will determine:
  - If the Project is in compliance with the Services' biological opinions;
  - if adverse Project effects have been found; and
  - if any modification to the Project's compliance, monitoring, research, and restoration actions are warranted.
- If an unanticipated effect is identified, the adaptive management team will determine whether:
  - The Project should continue;
  - construction or maintenance should be altered;
  - additional ecosystem restoration should be completed;
  - construction or maintenance should be stopped until more data is collected; or
  - the construction activities should be halted.

The Corps will be responsible for implementing the adaptive management team decisions regarding adverse Project effects. Annual reviews by the adaptive management team will occur for the duration of monitoring actions proposed in the 2001 BA. The adaptive management team shall make all monitoring and research data available for public review.

3.2.7 Ecosystem Restoration and Research Actions

The Corps has incorporated ecosystem restoration and research actions into the proposed action to assist with the recovery of ESA-listed salmonid habitats, and to further the understanding of ecosystem functions and processes. These actions are not proposed to directly mitigate or compensate for any Project-related impacts to ESA-listed salmonids. The research and restoration components of the overall ecosystem restoration and research action are proposed as Conservation Measures under Section 7(a)(1) of the ESA and have been included into the proposed action by the Corps. These actions are the Corps' commitment to fulfill their affirmative responsibility to assist with conservation and recovery of ESA-listed salmonids. These actions include those ecosystem research actions previously authorized under Section 101(b)(13) of the Water Resource Development Act of 1999, and additional ecosystem restoration features developed during the reinitiation of consultation.

Ecosystem Restoration Features. The ecosystem restoration features are designed to create or improve salmonid habitat, specifically tidal marsh, swamp, and shallow water and flats habitat, and to improve fish access to these habitat features (Table 3.7). In addition, one of the ecosystem restoration features would restore habitat and reintroduce Columbian white-tailed deer onto Cottonwood/Howard islands. The 2001 BA (and section 6 of this Opinion) provides a detailed description of these restoration features. Those descriptions are incorporated herein by reference. All ecosystem restoration features, except for the long-term Tenasillahe Island restoration feature, will be initiated during the Project construction period.

Three of the ecosystem restoration features originally proposed by the Corps will not be constructed. In a November 13, 2003, letter from the Corps to NMFS, the Corps explained that they will be unable to construct Lois Island Embayment and Millar/Pillar Habitat ecosystem restoration features due to Project modifications imposed by the state of Oregon as a result of their 401 certification and Coastal Zone Management Act review. Similarly, the Martin Island embayment modification will not be constructed due to objections from the State of Washington.

Table 3.7 Proposed Ecosystem Restoration Features

Action	Purpose	Monitoring
Purple Loosestrife *(Lythrum salicaria)* Control Program	Implement an Integrated Pest Management Plan for purple loosestrife in the estuary, RM 18-52	Annual and final reports describing results of control efforts
Tenasillahe Island Interim Restoration (Tidegate and Inlet Improvements)	Improve fish passage and water circulation between sloughs and the river	Post-construction benthic productivity and fish species composition and density on restoration and adjacent control sites, annual reporting
Tenasillahe Island Long-Term Restorations (Dike Breach)	Long-term restoration of historical habitat features, including	Post-construction benthic productivity and fish species composition and density on restoration and adjacent control sites, annual reporting
Cottonwood/Howard Island Proposal Columbian White-tailed Deer Introduction	Secure habitat and reintroduce Columbian white-tailed deer	Monitoring to assess success of translocation, and annual reports
Bachelor Slough Enhancement	Restore aquatic and riparian habitat resources	Monitor fish use of Bachelor Slough for 5 years, and annual and final reports
Shillapoo Lake Restoration	Creation of interior wetland cells for waterfowl and other wildlife species	None proposed
Columbia River Tidegate Retrofits	Improve fish passage at Columbia River and tributary tidegates	None proposed
Walker-Lord and Hump-Fisher Islands Improved Embayment Circulation	Dredge connecting channels between islands to increase water circulation	None proposed

Ecosystem Research Activities. Ecosystem research actions are conservation measures proposed by the Corps as part of the proposed action to assist the efforts of the Corps, NMFS, FWS, and others in the broader understanding the of Lower Columbia River ecosystem, and to assist with the recovery of ESA-listed salmonids (Table 3.8). The 2001 BA (Chapter 8, Table 8-1) provides a tabular description of these research actions, and is incorporated herein by reference. These research actions were negotiated and designed by the BRT to provide useful information to the recovery of the ESA-listed salmonids. The proposed research activities also address specific conceptual ecosystem model indicators that are believed to be improperly functioning.

Table 3.8 Proposed Ecosystem Research Actions

Research Task	Justification	Duration	Data Analysis
Add two additional transects in different habitat types similar to those being done for the NMFS studies currently under way with annual fish evaluation process.	Provide additional habitat and salmonid distribution information for the estuary. Useful in establishing inventory information for future monitoring or restoration.	Begin before construction and for 3 years after completion of the Project.	Record value and use of different habitat types for juvenile salmonids and cutthroat trout.
Evaluate cutthroat trout use of the estuary and river areas.	Little is known about the species use of this habitat. Research to provide additional information regarding salmonids use of this habitat.	Conduct study for 2 years before construction and 2 years during construction.	Record value and use of different habitat types for juvenile salmonids and cutthroat trout.
Conduct bank-to-bank hydrographic surveys of the estuary.	Has not been done in 20 years and is needed to assess available habitat and restoration actions.	Once, before construction.	Bathymetry will be available for shallow water areas in the estuary.
In conjunction with ongoing studies of juvenile salmonids habitat utilization in the Lower Columbia River, collect and analyze juvenile salmonids and their prey for concentrations of chemical contaminants.	Provide additional data on contaminants in listed salmonids and their prey. Useful in establishing inventory information for future monitoring or restoration.	Begin before construction and for 3 years after construction, depending on the results.	Record concentrations of persistent contaminants (*e.g.*, DDTs, PCBs, PAHs, dioxin-like compounds) in juvenile salmonids and prey.
In conjunction with above contaminant study, assess sublethal effects of contaminants (*e.g.*, growth, disease resistant) on salmonids.	Provide additional data for established contaminants thresholds effect levels to ensure that guidelines are Protective of salmonids; to better characterize performance of juvenile salmonids in the estuary.	Begin before construction and for 3 years after construction, depending on the results.	Record health status of juvenile salmonids Collected above.
Estuarine Turbidity Maximum (ETM) workshop.	To further the knowledge of the ETM and the listed stocks.	Once.	Not Required.

4. BIOLOGICAL INFORMATION

4.1 General Status of ESA-Listed Salmonids

NMFS has determined that the proposed action has the potential to adversely affect ESA-listed salmonids. Based on migratory timing, ESA-listed salmonids will be present in the action area during Project construction and operation and maintenance of the 43-foot channel. A general discussion of species status can be found in the November 2004 FCRPS Hydropower Biological Opinion, Chapter 4.0, Range-wide Status of the Listed Species.

4.2 Biological Requirements of Salmonids as Defined by the Conceptual Ecosystem Model

The Lower Columbia River, estuary and river mouth play a critical role in the survival and recovery of ESA-listed salmonids by providing refugia, nutrients, and conditions in which juvenile salmon undergo the physiological change from fresh-water to saltwater. NMFS' recently developed Cumulative Risk Initiative (CRI) modeling supports this conclusion. The CRI estimates population growth rates and uses this measure to assess the risk of extinction or of species decrease in abundance. The CRI analysis suggests that significant opportunities exist for securing additional improvements in overall population trends of ESA-listed salmonid stocks by reducing the substantial mortality in the estuarine and early ocean life stages (Kareiva *et al*., 2000).

In discussions of the importance and complex nature of the Lower Columbia River, estuary and river mouth to salmonids, the SEI panel identified the need for a consistent framework for understanding this ecosystem. The BRT worked with the SEI panel to develop a conceptual ecosystem model of the Lower Columbia River, estuary and river mouth ecosystem relationships that are significant for ESA-listed salmonids. The conceptual ecosystem model describes the physical and biological interactions of the Lower Columbia River and estuary in a manner that characterizes properly functioning habitat conditions for the system. The 2001 BA (Chapter 5 and Appendix E) provides an extensive presentation and discussion of the conceptual ecosystem model, and describes the historic and current conditions of the Lower Columbia River, estuary, and river mouth using the model. These descriptions are incorporated herein by reference.

In NMFS' 1999 biological opinion for this Project, we determined that the biological requirements NMFS considered to be most relevant to ESA-listed and salmonids were: (1) Habitat characteristics in the Lower Columbia River and estuary ecosystems that function to support successful migration, smoltification, and rearing; and (2) water quality that supports survival and recovery of ESA-listed salmonids. For the purposes of this reinitiation analysis, these biological requirements for ESA-listed salmonids have been included into the conceptual ecosystem model developed for the Project.

The following is a summary, based on the conceptual ecosystem model, of the Lower Columbia River, estuary and river mouth's ecosystem components, and how these factors collectively influence the growth and survival of the salmonid species rearing in and migrating through the Columbia River and estuary. Table 2-1 of the 2001 BA, Conceptual Model Pathways and Indicators for Juvenile Salmonid Production in the Lower Columbia River, is incorporated by reference.

4.2.1 Habitat-Forming Processes

Habitats are formed primarily by the interaction of hydrodynamic forces and sediment supply. In the Lower Columbia River, estuary and river mouth, both the river and the ocean influence the riverine and estuarine hydrodynamics. Ocean processes, including tidal action and waves, interact with river processes, including currents and sediment transport, in the Lower Columbia River, estuary and river mouth to produce complex hydrodynamics. The net result is deposition (accretion) of suspended sediments to form flats and carving (erosion) to form shallow and deep channels. These habitats may be colonized by marsh and swamp vegetation, as controlled by bathymetry (elevation of substrate) and, in the estuary, salinity. Because plants and animals are adapted to certain salinity ranges, the salinity level, as well as seasonal and spatial patterns, strongly influences where species occur in the Lower Columbia River and estuary. If the turbidity levels are low enough to allow sufficient light penetration for plant growth, certain areas may develop submerged vegetation such as eelgrass. Woody debris, deposited on the flats, along channel edges, and in marshes and swamps, creates a complex, vertical structure. Habitats in deeper riverine and estuarine areas are formed by bedload transport, which shapes portions of the river and estuary bed into a series of sand waves. All of these dynamics and interactions culminate in the expression of habitat types important to salmon in the Lower Columbia River and estuary.

4.2.2 Habitat Types

The basic riverine and estuarine habitat-forming processes—physical forces of the ocean and river—create the conditions that define habitats. Key habitat types (*i.e.*, tidal marsh and swamp, shallow water and flats, and water column), in turn, provide an opportunity for the primary plant production that gives rise to complicated food webs. All of these pathways combine to influence the growth and survival and, ultimately, the production and ocean entry of juvenile salmonids moving through the Lower Columbia River and estuary.

The Lower Columbia River and estuary extends the freshwater habitat of salmon and expands habitat available for rearing (Wissmar and Simenstad, 1998). The estuary serves as a conduit to the ocean, transporting fish from the river to the ocean, and provides critical adult holding, spawning, incubation, juvenile rearing habitat and migration corridors for ESA-listed salmonids. Estuary conditions have an important effect on salmon survival (Emmett and Schiewe, 1997; Hinrichsen *et al*., 1997), and on the number of salmon that can be supported in the Columbia River system.

Structural and biological features of estuarine habitats that provide refugia from predators and off-channel areas protected from strong tidal and river currents are important to salmon survival. Important features that can minimize effects of predators and strong flows include: Complex dendritic tidal channel systems and other landforms (islands, peninsulas, *etc*.); wood, emergent vegetation, or other structural components; and connections between mainstem channels and floodplains. Availability of refugia under variable tidal and river flow levels is necessary to support diverse rearing and migratory behaviors and thereby spread the physical and biological risks to salmon through time and space.

Persistence and resilience of Pacific salmon are linked to the quantity and quality of habitats throughout the range of their life history, from freshwater spawning to oceanic rearing environments. But salmonid ecosystems are not static; freshwater, estuarine and ocean conditions vary over many time scales, but seldom in synchrony. To compensate for such uncertainty, salmon have evolved a diversity of life-history traits that allow them to function in a variable environment (Wissmar and Simenstad, 1998; Bottom *et al*., 2001).

The quality and diversity of estuarine rearing habitats are important factors influencing the diversity of salmon life-history types that enter a variable ocean environment. For example, salmon populations within and among species enter the Columbia River estuary at different times, reside for varying periods, and select different habitats in time and space. This variety of rearing strategies minimizes the risk of brood failure, since not all individuals behave identically under the same set of environmental conditions. Slightly different patterns of migration and rearing in the estuary are advantageous in different years depending, for example, on the timing of flood events, the onset of the spring transition, the distribution of coastal upwelling, the timing of prey production, and the distribution of predators.

Continued survival of juvenile salmon in the ocean is often dependent on prior growth in the estuary, which is largely supported by detrital food chains and prey species from a variety of estuarine habitats. Important rearing habitats for juvenile salmon include those that produce, retain, and concentrate macrodetritus in the high-flow environment of the Columbia River estuary. Among areas of production and accumulation of organic matter are dendritic tidal channels and backwater sloughs, estuarine and tidal-freshwater marshes and swamps, vegetated riparian habitats, mud and sandflats of shallow peripheral bays, and the microdetrital producing estuarine turbidity maximum zone in the mainstem channels.

The habitats most directly linked to salmonids in the Lower Columbia River and estuary include the tidal marshes and swamps, shallow water and flats, and the water column. The position and extent these habitats that allow juvenile salmon gradually to adapt to saltwater are particularly important to their performance and survival.

Tidal marshes and swamps generally occur between Mean Higher High Water (MHHW) and the Mean Lower Low Water (MLLW). Tidal marshes begin at lower tidal elevations, slightly above MLLW, and swamps occur at or above MHHW. Juvenile salmonids use the edges of these marshes to feed, and the edges of shallow channels within the marshes as refugia and feeding areas. Tidal marshes can be divided into saltwater marshes and freshwater marshes, each characterized by a distinctive vegetation type.

Tidal marshes include tidally-influenced areas all the way up to Bonneville Dam, as well as extensive tidal freshwater marshes in the Lower Columbia River, particularly those in Cathlamet Bay. Availability of feeding habitats and refugia within the oligohaline or brackish zones of the estuary constitute a critical transition area for smaller salmon juveniles when they first enter saline waters. The proper function of habitats in this area and their linkage to adjacent habitats require that salmon can move freely upstream and downstream as needed to adjust their distribution with changes in the salinity gradient.

Shallow water and flats occur throughout the intertidal zone and into the shallow subtidal zone in waters up to six feet deep. Benthic algae (largely benthic diatoms) develop on tidal flats and in the shallow subtidal zone within the system. Juvenile salmonids use shallow water and flats habitats for feeding and movement.

Water column habitat refers to waters that are greater than 6 feet deep. Freshwater plankton dominate the fresh and oligohaline portions of the water column upstream, and plankton tolerant of greater salinity dominate the estuary and the river mouth of water column habitats. Juvenile salmonids utilize water column habitat for feeding and movement.

Habitat Primary Productivity Pathway. A major function of the habitats is to produce food used by organisms in the ecosystem. Habitat primary productivity refers to the amount of material (biomass) produced over time during plant growth that occurs within each habitat type. Primary productivity is driven by light and is supported by inorganic nutrients (*e.g*., nitrate, phosphate). Inorganic nutrients enter the system from the upstream watershed and the downstream ocean currents and through the breakdown and recycling of organic matter within the system. Live plant material and detritus are the primary sources of organic matter in the food web used by salmonids in the Lower Columbia River, estuary and river mouth.

Primary productivity within water column habitat results from imported and resident phytoplankton. Imported phytoplankton are freshwater species produced in large quantities in the upstream watershed (particularly in the reservoirs behind the mainstem Columbia River and tributary dams), whereas resident phytoplankton are produced within the Lower Columbia River and estuary.

Primary productivity within the shallow water and flats habitat results mostly from benthic algae. Shallow water habitats can also produce filamentous algae and flowering grasses such as eelgrass, however, the majority of primary productivity within the river's shallow water areas comes from benthic algae.

Primary productivity within tidal marsh and swamp habitat comes from the marsh and swamp vegetation, which includes emergent plants, shrubs, and trees.

Food Web Pathway. The base of any food web is the plant material produced over time or the primary productivity within each habitat type. The food web described in the conceptual ecosystem model includes macrodetritus, the large, complex forms of dead plants, primarily from tidal marsh plants. Macrodetrital webs are supported by tidal channels and backwater sloughs, marshes and swamps, vegetated riparian habitats, and other shallow water and low velocity habitats. This food web also includes microdetritus, the material from simple-celled plant or organic particles. Microdetritus can be in the form of imported microdetritus if they are derived from imported phytoplankton, or resident microdetritus if they are derived from resident phytoplankton. Small animals that shred the larger plant matter and microbes, including bacteria, protozoa, and fungi, facilitate the breakdown of detritus. In addition to making the organic matter useful to the food web, these breakdown processes recycle inorganic nutrients needed by the plants for primary production.

Fish and invertebrate community surveys in the Lower Columbia River and estuary provide strong evidence that physical processes that concentrate organic matter and maintain zooplankton populations in the estuary control the feeding environment for estuarine fishes (Bottom and Jones, 1990). Salmonids eat invertebrate prey species that are supported by resident and imported microdetritus, and macrodetritus from tidal marsh and swamp plant material. The relative amount of food and food energy depends on the abundance of each habitat type (*e.g*., tidal marshes) and the input of nonresident material from upstream sources. Several types of invertebrate prey species make up the next level up the food chain from the primary producers and their detritus.

Mobile macroinvertebrates are large epibenthic organisms, such as sand shrimp, mysids, and Dungeness crab, that reside on the river bottom and feed on bottom sediments and byproducts of primary productivity. Mysids are the primary macroinvertebrates that are relevant to the salmonid food web. Floating insects (larvae and adults) also appear to be important in the diet of most of the salmonid species and age classes in the salmonid food web. Many of these insect types feed on live tidal marsh plants.

Deposit feeders are benthic animals that feed by consuming organic matter in sediments. The term deposit feeders refers to both surface and subsurface deposit feeders, which include marine annelids (polychaetes), and freshwater annelids (oligochaetes), and benthic crustaceans. Suspension feeders are organisms that feed from the water column itself. For zooplankton and benthic/epibenthic organisms, this is accomplished primarily through 'filter feeding' (extracting organic matter from the water column by pumping or siphoning the water through their systems). Among the most abundant species found in the stomachs of salmonids is the planktonic cladocera suspension feeder *Daphnia pulex*.

Suspension/deposit feeders are benthic and epibenthic organisms that feed on or at the interface between the sediment and the water column. Because of the shift in the Lower Columbia River to more of a 'microdetrital' food web (*see* discussion below), the suspension/deposit feeder *Corophium salmonisis* now perhaps the most abundant species found in the stomachs of salmonids. However, nutritionally, *Corophium* may not be as desirable as other food sources for young salmon. According to Higgs, *et al*. (1995), gammarid amphipods such as *Corophium* are high in chitin and ash and low in available protein and energy relative to daphnids and chironomid larvae.

Thus, there has been a shift in the food web within the Lower Columbia River. Tidal marsh and swamp vegetation and macrodetritus have declined. The benthic/epibenthic food web, which was a prominent feature of the historical Lower Columbia River ecosystem, no longer produces as varied or rich a food web (Sherwood, *et al*., 1990). The current ecosystem is now more dependent on a 'microdetrital' food web supported by the Estuarine Turbidity Maximum (ETM) zone in the mainstem channels.

The ETM results from the combination of two processes, strong tidal forces and its interaction with the salt wedge in the Lower Columbia River. This combination results in elevated levels of suspended particulate matter. The physical process occurs when strong tidal forces push salinity upriver beneath the outflowing river water. The turbulence caused by this tidal forcing results in resuspension of sediment and other particulate material present on the riverbed. Concurrently, dissolved material in the river water flocculates when it comes into contact with the salt wedge pushing its way up river. The interaction of these forces results in the ETM.

The ETM supports the detrital food chain and salmon production, and in the current estuary the ETM sustains the highest secondary productivity (Simenstad *et al*., 1990). Fish and invertebrate community surveys in the Columbia River estuary provide strong evidence that physical processes that promote concentration of organic matter and the maintenance of zooplankton populations within the estuary control the feeding environment for estuarine fishes (Bottom and Jones, 1990). With the degradation of the macrodetrital food chain, the ETM has assumed an important role in providing food for salmon that enables them to mature properly and enhances their ability to survive.

Growth Pathway. Salmonids are adapted for using a complex mosaic of many habitat areas as they migrate downstream, and during their residence in the Lower Columbia River, estuary and river mouth. This mosaic of habitats used by salmonids is referred to as habitat complexity. An absence or reduction in the natural complexity of habitats available may affect the salmonids' ability to reach food resources needed for growth. Habitat conveyance is the opportunity for salmonids to move over flats and into tidal marsh systems as the water level rises and falls with the tide and with river flow. Connectivity refers to links and spatial arrangements among habitats in the mosaic of changing habitat areas. Feeding habitat opportunity reflects the variable access among feeding, rearing, and refuge habitats along the migratory corridor. Habitat-specific food availability needs to exist for salmonids to feed within the set of habitats. Lastly, low current velocity, shallow water areas provide productive feeding areas for salmonids. However, because salmonids are visual predators, turbidity and uneven bathymetry may influence their ability to successfully capture prey items.

Survival Pathway. Besides growth, a variety of factors interact to affect the ultimate survival of salmonids in the Lower Columbia River, estuary and river mouth. Factors that can negatively affect survival include contaminants, predation, suspended solids, temperature and salinity extremes, stranding, entrainment, and competition.

Contaminants may affect the health (physiological integrity) of salmonids and may result in disease as well as a reduced ability to physiologically adapt to saltwater, avoid predators, forage effectively, and seek and find shelter. Contaminants can be taken up directly through the water column or through contaminated prey. Predation is a major factor affecting salmonid survival in the Lower Columbia River, estuary and river mouth. Birds, including Western grebes, cormorants, gulls, terns, and great blue herons, are known to prey on salmonids. Piscine and pinniped predators also may prey salmonids. Suspended solids, which can be a major contributor to turbidity, may affect survival by reducing the ability of salmonids to see prey, and indirectly cause mortality via starvation. Temperature and salinity extremes typically stress fish, which may lead directly or indirectly to mortality. Stranding can occur when fish are washed up onto higher ground by waves or ship wakes, or if they are caught for extended periods of time in a shallow pool during an extended low tide. Fisheries biologists have observed stranding of salmonids in the Lower Columbia River system. Entrainment refers to the uptake of fish during dredging. Finally, competition between and among members of the outmigrating salmonid populations may play a role in survival, however, little is understood or documented regarding the effects of competition in the Lower Columbia River, estuary and river mouth.

5. ENVIRONMENTAL BASELINE

5.1 Introduction

The status of the ESA-listed salmonids in the Project area, and their risk of extinction, have not significantly changed since the species were listed. NMFS is not aware of any new data that would indicate otherwise. The environmental baseline, to which the effects of the proposed action are added, "include the past and present impacts of all Federal, state or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation process" (50 C.F.R. 402.02).

NMFS concludes that not all of the biological requirements of the ESA-listed species within the action area are being met under current conditions. Based on the best available information on the subject species' status, including population status, trends, and genetics, and the environmental baseline conditions within the action area, significant improvement in habitat conditions is needed to meet the biological requirements for the survival and recovery of the species. A substantial proportion the tidal marsh and swamp habitats that support migration, smoltification, and rearing have been lost or degraded by shoreland development, diking, dredging, and filling activities. A primary goal of habitat restoration in the Lower Columbia River and estuary is to increase the survival and recovery of salmon by restoring the spatial and temporal diversity and connectivity of habitats available that provide these biological requirements.

The discussion of the Environmental Baseline, below, is presented in two sub-sections. The first sub-section provides an overview of the current environmental conditions in the Lower Colombia River and estuary. The second sub-section provides current information on ESA-listed salmonids of the Lower Columbia River and estuary, and discusses the importance of the Lower Columbia River and estuary's physical processes and resultant habitats to those species.

5.2 Environmental Condition of the Lower Columbia River and Estuary

The Columbia River is naturally a very dynamic system. It has been affected and shaped over eons by a variety of natural forces, including volcanic activity, storms, floods, natural events, and climatological changes. These forces had and continue to have a significant influence on biological factors, habitat, inhabitants, and the whole riverine and estuarine environment of the Columbia River.

Over the past century, human activities have dampened the range of physical forces in the action area and resulted in extensive changes in the Lower Columbia River and estuary. To a significant degree, the risk of extinction for salmon stocks in the Columbia River Basin has increased because complex freshwater and estuarine habitats needed to maintain diverse wild populations and life histories have been lost and fragmented. Estuarine habitat has been lost or altered directly through diking, filling, and dredging. Estuarine habitat has also been removed indirectly through changes to flow regulation that affect sediment transport and salinity ranges of specific habitats within the estuary. Not only have rearing habitats been removed, but the connections among habitats needed to support tidal and seasonal movements of juvenile salmon have been severed.

The Lower Columbia River estuary has lost approximately 43% of its historic tidal marsh (from 16,180 to 9,200 acres) and 77% of historic tidal swamp habitats (from 32,020 to 6,950 acres) between 1870 and 1970 (Thomas 1983). One example is the diking and filling of floodplains formerly connected to the tidal river, which have resulted in the loss of large expanses of low-energy, off-channel habitat for salmon rearing and migrating during high flows. Similarly, diking of estuarine marshes and forested wetlands within the estuary have removed most of these important off-channel habitats. Sherwood *et al*. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970.

The total volume of the estuary inside the entrance has declined by about 12% since 1868. This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production. Sherwood *et al*. (1990) also analyzed early navigational charts and noted profound changes in the river entrance from year to year. The pre-development river mouth was characterized by shifting shoals, sandbars, and channels forming ebb and flood tide deltas. Before jetty construction, the navigable channel over the tidal delta varied from a single, relatively deep channel in some years to two or more shallow channels in other years.

Within the Lower Columbia River, diking, river training devices (pile dikes and riprap), railroads, and highways have narrowed and confined the river to its present location. Between the Willamette River and the mouth of the Columbia River, diking, flow regulation, and other human activities have resulted in a confinement of 84,000 acres of floodplain that likely contained large amounts of tidal marsh and swamp. The Lower Columbia River's remaining tidal marsh and swamp habitats are in a narrow band along the Columbia River and tributaries' banks and around undeveloped islands.

Since the late 1800s, the Corps has been responsible for maintaining navigation safety on the Columbia River. During that time, the Corps has taken many actions to improve and maintain the navigation channel. The channel has been dredged periodically to make it deeper and wider, as well as annually for maintenance. To improve navigation and reduce maintenance dredging, the navigation channel has also been realigned and hydraulic control structures, such as in-water fills, channel constrictions, and pile dikes, have been built. Most of the present-day pile dike system was built in the periods 1917-23 and 1933-39, with an additional 35 pile dikes constructed between 1957 and 1967.

The existing navigation channel pile dike system consists of 256 pile dikes, totaling 240,000 linear feet. Ogden Beeman and Associates (1985) termed these Corps activities 'river regulation,' and noted that navigation channel maintenance activities, for a 100-year period before their 1985 report, required closing of river side channels, realigning riverbanks, removing rock sills, stabilizing riverbanks, and placement of river 'training' features. Most of these baseline river training features and habitat alterations were constructed or occurred before any of the current ESA-listed salmonids were placed on the list of endangered and threatened species.

Flow regulation, water withdrawal and climate change have reduced the Columbia River's average flow and altered the seasonality of Columbia River flows, sediment discharge and turbidity, which have changed the estuarine ecosystem (National Research Council, 1996; Sherwood *et al*., 1990; Simenstad *et al*., 1990, 1992, Weitkamp, 1994). Annual spring freshet flows through the Columbia River estuary are approximately one-half of the traditional levels that flushed the estuary and carried smolts to sea, and total sediment discharge is approximately one-third of 19th century levels. For instance, flow regulation that began in the 1970s has reduced the two-year flood peak discharge, as measured at The Dalles, Oregon, from 580,000 cfs to 360,000 cfs (Corps, 1999).

Decreased spring flows and sediment discharges have also reduced the extent, speed of movement, thickness, and turbidity of the plume that extended far out and south into the Pacific Ocean during the spring and summer (Cudaback and Jay, 1996; Hickey *et al*., 1997). Changes in estuarine bathymetry and flow have altered the extent and pattern of salinity intrusion into the river and have increased stratification and reduced mixing (Sherwood *et al*., 1990).

These aforementioned physical changes also affect other factors in the riverine and estuarine environment. Tides raise and lower river levels at least 4 feet and up to 12 feet twice every day. The historical range for tides was probably similar, but seasonal ranges and extremes in water surface elevations have certainly changed because of river flow regulation. The salinity level in areas of the estuary can vary from zero to 34 parts per thousand (ppt) depending on tidal intrusion, river flows, and storms. Flow regulation has affected the upstream limit of salinity intrusion. The salinity wedge is believed to have ranged from the river mouth to as far upstream as RM 37.5 in the past. It is now generally believed that the salinity intrusion ranges between the mouth and RM 30. The riverbed within the navigation channel is composed of a continuously moving series of sand waves that can migrate up to 20 feet per day at flows of 400,000 cfs or greater, and at slower rates at lesser flows. This rate of river discharge is not experienced as often as it was before flow regulation in the Columbia River.

Development has changed the circulation pattern in the estuary and increased shoaling rates. Sediment input to the estuary has declined due to the altered hydrograph and the estuary is now a more effective sediment trap (Northwest Power Planning Council, 1996). Although the Columbia River is characterized as a highly energetic system, it has been changing as a result of development and is now similar to more developed and less energetic estuaries throughout the world (Sherwood, *et al*., 1990).

Water quality is another important aspect the environmental condition of the Lower Columbia River and ecosystem that the potential to affect salmonid's growth and survival. The uptake of toxicants during juvenile salmonid residence in the Lower Columbia River and estuary (NWFSC Environmental Conservation Division 2001) can affect their growth and survival. In field studies, juvenile salmon from sites in the Pacific Northwest show demonstrable effects, including immunosuppression, reduced disease resistance, and reduced growth rates, due to contaminant exposure during their estuarine residence (Arkoosh *et al*. 1991, 1994, 1998; Varanasi *et al*. 1993; Casillas *et al*. 1995a,b, 1998a).

Current environmental conditions in the Columbia River estuary indicate the presence of contaminants in the food chain of juvenile salmonids. Fish from a site near Sand Island, in the mouth of the Columbia River, whole body concentrations of dichlorodiphenyl trichloroethane (DDT) and polychlorinated biphenyls (PCB) were 44 ng/g wet wt (~ 220 ng/g dry wt) and 53 ng/g wet wt (~ 265 ng/g dry wt), respectively (Fig. 6) (NWFSC Environmental Conservation Division 2001). The findings of elevated levels of DDTs and PCBs in stomach contents of fish from Sand Island, however, is clear evidence that fish are being exposed to these contaminants while they are in the estuary. Levels of DDTs in stomach contents were 52 ng/g wet weight, and levels of PCBs were 33 ng/g wet weight. Although the Sand Island samples were collected from a mixed population of hatchery and wild fish and it is likely that DDTs and PCBs in hatchery food make some contribution to contaminant body burdens, the values seen were among the highest levels measured at estuarine sites in Washington and Oregon. By comparison, in the Duwamish estuary, a heavily contaminated industrial estuary near Seattle, mean whole body DDT levels in juvenile Chinook salmon were 25 ng/g wet wt (~125 ng/g dry wt) and whole body PCB levels were 68 ng/g wet wt (~340 ng/g dry wt)[NWFSC Environmental Conservation Division 2001, Fig. 6].

More recently, additional samples were analyzed from salmon collections in 1999 and 2000 (NWFSC Environmental Conservation Division, 2001). These analyses show that concentrations of PCBs and DDTs are consistently elevated in Chinook salmon collected from Sand Island in the mouth of the Columbia River. Measured concentrations of DDTs in salmon bodies ranged from 32 to 56 ng/g dry wt, and concentrations of PCBs ranged from 23 to 160 ng/g dry wt (NWFSC Environmental Conservation Division 2001, Fig. 8). No significant differences in mean concentrations of either of these contaminants were found over the three years during which fish were sampled. Elevated levels of PCBs and DDTs were also consistently found in stomach contents of sampled fish, indicating that juvenile salmon caught near Sand Island are taking these contaminants up in their diet.

The concentrations of PCBs present in Sand Island fish are a cause for concern, because they are approaching or even exceeding estimated threshold tissue concentrations for adverse effects in salmonids (Meador, 2000). These values range from 120-360 ng/g dry wt for fish with total body lipid concentrations of 1 to 3%, which are typical of juvenile salmon collected within Pacific Northwest estuaries. At an average of 265 ng/g dry wt, PCB concentrations in Sand Island fish are well within the range of the effects threshold.

Available data suggest that exposure to polyaromatic hydrocarbons (PAH) may be quite variable in juvenile salmon from the Lower Columbia River. In stomach contents of juvenile Chinook salmon collected near Sand Island in 1998, PAH concentrations were barely detectable, below levels seen in salmon from moderately developed estuaries such as Yaquina Bay and Grays Harbor, and well below levels found in stomach contents of salmon from industrialized waterways of Puget Sound (*e.g.*, Hylebos Waterway) (NWFSC Environmental Conservation Division 2001, Fig. 9). Similarly, concentrations of PAH metabolites in bile were relatively low in juvenile salmon from Sand Island in comparison to fish from urban Puget Sound sites (*e.g.*, the Duwamish and Hylebos Waterways) (NWFSC Environmental Conservation Division 2001, Fig. 10). Juvenile salmon sampled near Sand Island in 2000, however, showed somewhat greater exposure to PAHs than salmon sampled in 1998. Concentrations of PAHs and their metabolites in both stomach contents and fish bile were considerably higher in 2000 than in 1998 (NWFSC Environmental Conservation Division 2001, Fig. 11). Concentrations were still lower than those observed in fish from urban estuaries in Puget Sound, but were comparable to those observed in fish from moderately development estuaries along the Washington and Oregon coasts, such as Yaquina Bay or Coos Bay.

These data indicate that juvenile salmonids within the Columbia River estuary have contaminant body burdens that may already be within the range where sublethal effects may occur, although the sources of exposure are not clear.

5.2.1 Description of the Environmental Baseline for ESA-listed Salmonids the Lower Columbia River and Estuary

All ESA-listed salmonids must pass through the Lower Columbia River, estuary and river mouth twice: Once as juveniles en route to the Pacific Ocean and again as adults when they return to spawn. The Lower Columbia River and estuary serve three primary roles for outmigrating juveniles as they transition from shallow freshwater environments to the ocean possible: (1) A place where juvenile fish can gradually acclimate to salt water; (2) a feeding area (*i.e*., main, and tidal channel, unvegetated shoals, emergent and forested wetlands, and mudflats) capable of sustaining increased growth rates; and (3) a refuge from predators while fish acclimate to salt water.

Thus, though the Lower Columbia River and estuary is important to the survival and recovery of all ESA-listed salmonids, it is particularly important to ocean-type salmon. These stocks may be particularly sensitive to ecosystem changes because of their longer residence times and dependence on this portion of the river for growth and survival. In this consultation, NMFS focused on ocean-type salmon as an indicator of the importance of the Lower Columbia River and estuary to all ESA-listed salmonids. NMFS focused on ocean-type salmon because they are an indicator of the most sensitive salmonid response to changes in estuary and river habitats.

Ocean-type salmon ESUs in the Columbia River include Chinook ESUs (Lower Columbia River, Snake River fall, and Upper Willamette River) and Columbia River chum salmon ESUs. These ESUs are the most likely to be affected by potential impacts of the Project, and thus are discussed in detail below. Ocean-type salmon migrate downstream to and through the estuary as subyearlings, generally leaving the spawning area where they hatched within days to months following their emergence from the gravel. Consequently, subyearlings commonly spend weeks to months rearing within the action area before reaching the size at which they migrate to the ocean.

Young salmonids must undergo a physiological transition and develop enough strength, energy, and reserve capacity to adapt to and survive the physical and biological challenges of the ocean environment, as well as to successfully obtain prey in that environment. Juvenile salmonids appear to reach the threshold for this transitional state at a size of 70 to 100 mm. Before fish reach this size, their ocean survival would be difficult.

The first outbound migrants of the Lower Columbia River fall Chinook and chum may arrive in the action area as early as late February (Herrmann, 1970; Craddock, *et al*., 1976; Healey, 1980; Congleton, *et al*., 1981; Healey, 1982; Dawley, *et al*., 1986; Levings, *et al*., 1986). The majority of these fish are present from March through June. Outbound Snake River fall Chinook begin their migration much farther upstream and arrive in the Lower Columbia River approximately a month later.

Ocean-type subyearlings arrive in the lower river and estuarine portion of the action area at a small size. The earliest migrants can be as small as 30 to 40 mm fork length (*i.e.*, from snout to fork in the tail) when they arrive because some of these fish hatch only a short distance upstream from the action area. Later spring migrants are generally larger, ranging up to 50 to 80 mm. Subyearlings from the mid-Columbia and Snake Rivers tend to be substantially larger (70 to 100 mm) by the time they reach the Lower Columbia River. The larger size of the Lower Snake River fall Chinook, compared with the Lower Columbia River Chinook and chum, likely indicates some differences in suitable habitat. The larger subyearlings from the Snake River can likely use a greater range of depth and current conditions than the subyearlings of the Lower Columbia River ESUs can.

Once ocean-type subyearlings arrive in the Lower Columbia River, they may remain for weeks to months. Because these fish arrive small in size, they undergo extended lower river and estuary rearing before they reach the transitional size necessary to migrate into the ocean (70 to 100 mm). This larger size is necessary to deal with the physical conditions and predators they face in the ocean environment, as well as to be successful in obtaining prey in that environment. At growth rates of about 0.3 to 1 mm per day (Levy, *et al*., 1979; Argue *et al*., 1985; Fisher and Pearcy, 1990), the subyearlings require weeks to months to reach this larger size. During this time, young Chinook increase by about 5 to 8 grams per day or approximately 6% of their body weight (Herrmann, 1970; Healey, 1980).

Ocean-type subyearlings migrate through the riverine reach of the action area of the Project during their downstream migration (about 150 kilometers [km]). Because of this, many spend some time rearing within the riverine reach; however, there is considerable variability in the freshwater rearing period of subyearling populations. Some subyearlings spawned in the lower reaches of coastal tributaries migrate almost immediately to marine areas following emergence from the gravel. Other subyearlings rear in freshwater for weeks to months, particularly those spawned well upstream in larger river systems such as the Columbia. The migration rate for subyearlings undergoing the rearing migration through the riverine reach is likely to be a few to ten km per day. Subyearlings migrating directly to the estuary migrate at rates of 15 to 30 km per day (MacDonald, 1960; Simenstad, *et al*., 1982; MacDonald, *et al*., 1987; Murphy, *et al*., 1989; Fisher and Pearcy, 1990). Adult salmon returning to the Columbia River migrate through the river mouth throughout the year. The majority move through this area from early spring through autumn.

A number of physical characteristics in the riverine reach affect the quality and quantity of habitat available for salmonids. These include the availability of prey, temperature, turbidity, and suspended solids. Subyearlings are commonly found within a few meters of the shoreline at water depths of less than 1 meter. Although they migrate between areas over deeper water, they generally remain close to the water surface and near the shoreline during rearing, favoring water no more than 2 meters deep and areas where currents do not exceed 0.3 meter per second. They seek lower energy areas where waves and currents do not require them to expend considerable energy to remain in position while they consume invertebrates that live on or near the substrate.

These areas are characterized by relatively fine grain substrates. However, it is not uncommon to find young salmonids in areas with steeper and harder substrates, such as sand and gravel.

Young Chinook in the Lower Columbia action area consume a variety of prey, primarily insects in the spring and fall and *Daphnia* from July to October (Craddock, *et al*., 1976). *Daphnia* are the major prey during the summer and fall months, selected more than other planktonic organisms. Young salmonids consume diptera, hymenoptera, coleoptera, tricoptera, and ephemeroptera in the area just upstream from the estuary (Dawley, *et al*., 1986). Bottom and Jones (1990) recently reported that young Chinook ate primarily *Corophium, Daphnia*, and insects, with *Corophium* being the dominant prey species in winter and spring and *Daphnia* the dominant prey species in summer. Salmonids commonly feed on *Corophium* males, which apparently are more readily available than the larger females.

Corophium is commonly discussed as a primary prey item of juvenile salmonids in the Lower Columbia River. *Corophium salmonis* is a euryhaline species tolerating salinities in the range of zero to 20 ppt (Holton and Higley, 1984). As shown by the above investigations, it is one of several major prey species consumed by juvenile Chinook under existing conditions. No data are available that indicate its historical role in the diet of Columbia River salmon before substantial modification of the river system. Nutritionally, *Corophium* may not be as desirable as other food sources for young salmon. According to Higgs, *et al*. (1995), gammarid amphipods such as *Corophium* are high in chitin and ash and low in available protein and energy relative to daphnids and chironomid larvae.

Subyearling Chinook and chum first enter the estuary at about the same time that they enter the riverine potion of the Lower Columbia River because some of the fry move rapidly to the estuary by mid-March rather than rearing in the riverine areas (Craddock, *et al*., 1976; Dawley, *et al*., 1986; Levy and Northcote, 1982; Healey, 1982; Hayman, *et al*., 1996). As Chinook fry migrate to the estuary, they may remain in the low salinity or even freshwater areas for some time until they have grown somewhat larger (more than 75 mm) (Kjelson, *et al*., 1982; Levings, 1982; Levy and Northcote, 1982; MacDonald, *et al*., 1986; Shreffler *et al*., 1992; Hayman, *et al*., 1996). However, some Chinook fry appear to move immediately to the outer edges and higher salinity portions of the estuary (Stober, *et al*., 1971; Kask and Parker, 1972; Sibert, 1975; Healey, 1980; Johnson, *et al*., 1992; Beamer, *et al*., 2000).

Ocean-type fish commonly have the capacity to adapt to highly saline waters shortly after emergence from the gravel. Tiffan, *et al*. (2000), determined that, once active migrant fall Chinook passed McNary Dam 470 km upstream from the Columbia River's mouth, 90% of the subyearlings were able to survive challenge tests in 30 ppt seawater at 18.3°C. Other investigators have found that very small Chinook fry are capable of adapting to estuarine salinities within a few days (Ellis, 1957; Clark and Shelbourn, 1985). Wagner, *et al*. (1969), found that all fall Chinook alevins tested were able to tolerate 15 to 20 ppt salinity immediately after hatching.

While tidal exchange with the ocean tends to keep estuary temperatures at moderate levels (ten to 20˚ C) throughout the time the outmigrants are present, spring and summer temperatures vary widely in shallow water when tidal flats are exposed by low tides during sunny midday periods. Consequently, young salmonids rearing in shallow water naturally experience a wide range of temperatures within periods of less than a day. The available observations of the behavioral reaction of young salmonids to temperatures in estuarine conditions are variable. Bessey (1976) found hatchery Chinook and wild chum avoided water of 16°C. These fry responded immediately to increases of less than 1°C; however, the fry did not avoid rapid increases of more than 1°C per minute. Temperatures in the estuarine reach may range from zero to 26°C, but 12° to 14°C is optimum for young salmon (Bottom, *et al*., 2001).

In the estuary, turbidity is important in relation to the ETM zone. Relatively high turbidity is a characteristic of the intermixing of freshwater and saltwater in the ETM. However, Jones, *et al*. (1990), concluded that, in the Lower Columbia River, the standing stocks of benthic animals were highest in the protected tidal flat habitats, while those of epibenthic and zooplanktonic organisms were concentrated within the ETM. Because prey species have differing tolerances for salinity, increased salinity in the estuary results in different prey species being available to the rearing fry than those in the freshwater riverine reach, and in a change in the abundance of those prey species that are found in both the estuarine and riverine reaches.

In addition, young salmonids in the estuary continue to eat many of the same organisms as are consumed in the riverine reach of the Lower Columbia River, but there are shifts in prey abundance. Young Chinook and chum at Miller Sands in the upper estuarine reach feed primarily on the pelagic prey *Daphnia longispina* and *Eurytemora hirundoides,* the benthic prey *Corophium salmonis*, and chironomid larvae and pupae (McConnell, *et al*., 1978). Diet overlaps considerably among the different species. Many yearlings passing through the lower river were found to have empty or less than full stomachs (Dawley, *et al*., 1986).

As young salmonids leave the estuary, they migrate through the river mouth. At the river's mouth, there tends to be more wave and current energy than other portion of the estuary. The ocean area immediately outside the river mouth is characterized by high salinity during low to moderate flows and by high wave energy with no shoreline for protection. It is likely that young salmonids pass through the river mouth from March through the autumn months during the same time they are present in the estuary. Some individuals may migrate out of the estuary early and other late in the general migration period of each ESU.

Outside the river mouth, young salmonids enter the ocean, where high salinity and the absence of available shoreline require them to adapt to a pelagic life style. Pearcy, *et al*. (1990), found Chinook in near-surface waters up to 46 km offshore from Oregon and Washington during the summer months, but absent from this area by mid-September. Orsi, *et al*. (2000), found juvenile Chinook, chum, and pink salmon were most abundant in the shoreline (strait) waters of southeast Alaska during June and July when zooplankton abundance was highest. Food availability may also be a factor in the timing of Columbia River salmon migration; however, Brodeur (1992) concluded that food availability off the Oregon and Washington coasts was not a limiting factor.

Adult salmon returning to the Columbia River migrate through the river mouth throughout the year. The majority move through this area from early spring through autumn.

6. EFFECTS OF THE PROPOSED ACTION

6.1 Introduction

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, NMFS will evaluate the net combined effects of the proposed action and the offsite measures as interrelated actions.

'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 C.F.R. 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

'Indirect effects' are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone Section 7 consultation but will result from the action under consideration.

The proposed Project has several distinct components, including Project construction and maintenance activities, monitoring and adaptive management, and ecosystem restoration and research actions. Section 6 of this Opinion includes sub-sections that address each Project component separately. Section 6.8 of this Opinion summarizes the effects analysis. Section 9 then provides our conclusion whether the Project, as a whole, jeopardizes the continued existence of ESA-listed salmonids or destroys or adversely modifies critical habitat. This is accomplished by aggregating effects to each pathway and indicator, when considered together with effects from interrelated and interdependent actions, cumulative effects and the environmental baseline.

As noted in section 3 of this Opinion, several steps were involved in development of the current proposed action. Those steps included a re-evaluation of potential Project effects, an analysis of these potential effects within the framework of an ecosystem-based conceptual ecosystem model, the development of compliance measures and monitoring conditions to minimize and/or avoid Project impacts, and the development of an adaptive management process to review information from the compliance and monitoring activities and make necessary Project modifications to minimize and/or avoid impacts. By using this 'frontloading' approach, NMFS and the Corps defined a proposed action that minimized or avoided Project-related effects. Therefore, some of the indicators identified in the conceptual ecosystem model are not discussed in this Opinion because the Corps' proposed action successfully avoids effects to them (*see* Table 2-1 of the 2001 BA for indicators not included for analysis in this Opinion).

NMFS used the conceptual ecosystem model, numerical models, and the results of BRT deliberations to analyze potential Project effects. The pathways and indicators defined in the conceptual ecosystem model (*see* Chapter 5 of the 2001 BA) are used herein as a framework to discuss potential Project effects. Pathways and indicators that could be potentially affected by the Project are addressed in sections 6.2.1 and 6.2.2 of this Opinion.

To determine specific physical habitat changes (salinity, velocity, depth) that might occur after Project implementation, the BRT used two numerical models, the Corps of Engineers – WES RMA-10 model and the OHSU/OGI ELCIRC model. The BRT was also assisted by the SEI panel process, which reviewed multiple aspects of the proposed Project (*e.g.*, historical and existing status of the Lower Columbia River ecosystem, numerical modeling of hydraulic parameters, including flow and bathymetry; salmonid estuarine ecology; sediments and sediment quality, and monitoring and adaptive management). The 2001 BA (*see* Section 6 and Appendices B, F, and G) provides a complete overview of these analysis techniques and results of quantitative analyses and modeling outputs, and is incorporated herein by reference.

The above analyses addressed the concerns raised in NMFS' August 25, 2000, biological opinion withdrawal letter. The SEI panel process was used to respond to the concerns raised in our August 25, 2000, withdrawal letter, helped to frame major concerns raised in connection with the proposed Project, and identified best available science for additional analysis of Project effects. The Corps also conducted additional numerical modeling for the Lower Columbia River and estuary (*see* above discussion).

To develop the effects analysis for the 2001 BA, the BRT utilized the scientific information identified during the SEI panel process, including the best available science provided by NMFS' Northwest Fisheries Science Center, which describes the effects of bathymetry on ecological conditions of the estuary, and new information regarding potential effects of contaminants that could be released by Project activities. This best available scientific data and information was also used in developing the Terms and Conditions identified in section 12 of this Opinion, the Incidental Take Statement.

NMFS also expressed concern regarding the Corps' ability to restore estuarine habitats as identified in the 1999 biological opinion. This concern has also been resolved. In their 2001 BA, the Corps proposed an expanded set of ecosystem restoration features (*see* Table 8-2 of the 2001 BA) that are included in the proposed action that the Corps has committed to implement. These restoration actions will be funded by the Corps as integral Project components.

The following analysis of potential direct and indirect effects to salmonids and their habitats (sections 6.2 - 6.7 of this Opinion) from construction and maintenance activities uses the conceptual ecosystem model indicators and focuses on Project-related effects to key habitat types. This section also discusses interrelated and interdependent actions and their associated effects. Uncertainty regarding Project-related effects and associated risk to ecosystem indicators is presented, along with monitoring and adaptive management measures proposed by the Corps to reduce Project-related risk and uncertainty. This section of the Opinion also addresses potential effects resulting from proposed monitoring, ecosystem restoration, and research proposals. Finally, NMFS' conclusions on overall Project-related effects are presented.

6.2 Effects from Construction and Maintenance Activities

Project construction, maintenance, and compliance activities may have immediate (direct) effects to salmonids, as well as short-term and long-term (indirect) effects to ecosystem processes and functions of importance to salmonids. Additional activities, interrelated to the proposed action, may also have indirect effects to ESA-listed salmonids. NMFS uses the pathways and indicators from the conceptual ecosystem model as an analytical framework for discussing indirect effects from construction and maintenance activities. NMFS assumed that, if a pathway or indicator is influenced by the Project, then an indirect, short- or long-term impact to salmonids and their habitats may also may occur.

6.2.1 Direct Effects

Direct mortality to salmonids from construction and maintenance activities could occur from entrainment during dredging, disposal, or during in-water blasting activities. NMFS assumes that any salmonid entrained by the dredging activities will suffer injury or perish. Entrainment of organisms by hopper dredging has been evaluated at the mouth and in the Columbia River (Larson and Moehl, 1990; R2 Resources Consultants, 1999). Larson and Moehl (1990) reported that no juvenile or adult salmonids were collected during the four years of the study, even though other pelagic fish species were collected. This study concluded that, because dredging occurred below the depth where salmonids migrate, no salmonids were entrained. Documented entrainment of salmonids occurred during a research study in which the dredge draghead was purposely operated while elevated in the water column instead of within the substrate to determine presence/absence of fish (R2 Resource Consultants 1999). This entrainment incident involved two salmonids. No juvenile salmonids have been entrained during monitored, normal dredging operations in the Columbia River (Larson and Moehl 1990).

Under the Corps' proposed Project dredging procedures, the draghead and/or cutterhead will be buried, to the extent possible, in the sediment of the riverbed during dredging operations. No suction will occur through the draghead and/or cutterhead if it is raised more than 3 feet off the river bottom. Both these proposed "impact minimization" measures reduce the potential for juvenile salmonid entrainment.

Observations of subyearling and juvenile ESA-listed salmonid distribution and relative vulnerability to dredging entrainment impacts were conducted in the Lower Columbia River (Carlson *et al*., 2001, Beeman *et al.* 2003). Research indicated that the majority of salmonids were not utilizing the bottom of the navigation channel, where entrainment might occur during dredging activities. Analysis of hydroacoustic sampling data revealed that, during the highest ESA-listed fish annual abundance in the Lower Columbia River, only 0.0017% of those fish were beside the dredging zone (within three feet of the navigation channel bottom) during the daylight hours; 0.0249% were beside the dredging zone in the evening hours, and 0.0107% were beside the dredging zone at night (Carlson *et al*., 2001). The combination of very limited occupancy by ESA-listed salmonids of deep water locations, and BMPs that restrict dredge draghead or cutterheads to be operated, to the extent possible, under the sediment surface, will ensure that entrainment of ESA-listed salmonids is minimized. It is believed that adult salmonids have sufficient swimming capacity to avoid entrainment, and are further protected by the dredging "impact minimization" actions noted above. NMFS believes that compliance monitoring, to ensure the proposed entrainment minimization measures are implemented, will be important in minimizing any injury or death of salmonids during dredging activities.

One location (Warrior Rock, RM 87.3) may require one-time, in-water blasting. NMFS anticipates blasting could injure or kill salmonids within the blasting area. However, the proposed action minimizes potential direct effects by requiring a blasting plan, using an in-water work window of November 1 to February 28 when salmonid abundance is lowest, and reducing the associated pressure wave by creating an implosion. NMFS believes reducing implosion-induced over-pressure to less than ten psi will minimize blast-related impacts to salmonids. NMFS believes that development of a NMFS-approved monitoring plan, that ensures the proposed blasting measures are implemented, will be important to minimize any injury or death of ESA-listed salmonids during blasting activities.

Dredge material disposal has the potential to cause direct effects to ESA-listed salmonid habitat along the Columbia River. Disposal areas were sited primarily on existing dredged material disposal sites or at locations behind flood control dikes. Typically, these disposal sites provide negligible inputs (*e.g.*, detrital and insect faunal export, large woody debris export) to the Columbia River, and thus are of limited value to ESA-listed salmonids. As a result, direct effects of dredged material disposal are not expected to be significant.

Habitat development, principally riparian and wetland habitats, is the principal thrust for restoration actions. Restoration actions at Webb and Woodland Bottoms locations would occur behind flood control dikes under the current prescription. Insect faunal export from these locations would occur although they would not be as substantial as for locations directly connected to the Columbia River. The proposed restoration feature at Shillapoo Lake occurs behind flood control levees where there is currently no access by ESA-listed salmonids. Construction impacts to wetland habitats would be contained behind the levees and would not affect ESA-listed salmonids.

6.2.2 Indirect Effects

The 2001 BA determined that, of the 38 conceptual ecosystem model indicators that potentially could be influenced by the Project's construction, maintenance, and effects minimization activities, a total of 20 indicators of ecosystem process and function may be influenced. After review of the conceptual ecosystem model (*see* Chapter 5 of the 2001 BA) and the effects analysis in the 2001 BA (*see* Chapter 6), NMFS analyzed five habitat forming process indicators (suspended sediment, bedload, turbidity, salinity, bathymetry) and three key habitat types (tidal marsh and swamp, shallow water and flats, and water column) associated with physical and biological indicators that could be potentially be affected by the Project.

The seven key indicators (insects, macrodetritus, microdetritus, benthic algae, deposit feeders/suspension-deposit feeders/suspension, mobile macroivertebrates, and phytoplankton) that link the prey base to ESA-listed salmonids are integrated into the discussion of key habitat types in which they are primarily found. The habitat complexity, connectivity, and conveyance; feeding habitat opportunity; refugia; and habitat-specific food availability indicators are analyzed as a grouping because they can affect more than one habitat type, and this grouping better reflects an ecosystem approach to impact assessment.

The final indicator analyzed, fish stranding, potentially results from deep-draft vessel traffic that is interdependent to the Project, and is thus addressed in section 6.5 of this Opinion.

Ecosystem Indicator - Suspended Sediment (including an analysis of accretion and erosion). Proposed dredging and disposal actions and future interrelated activities may influence suspended sediment concentrations in the Lower Columbia River, estuary and river mouth. In areas beside dredges and shoreline disposal operations, increases in suspended sediment concentrations may temporarily increase local water column turbidity.

Dredging operations are likely to cause downstream suspended sediment increases of zero to two mg/L, depending on the number and type of dredges operating. Most of the dredging and disposal-induced suspended sediment should rapidly settle onto adjacent substrates. Ocean disposal will result in longer periods of sediment suspension before the sediment settles onto the deepwater substrate. Based on the data indicating that less than 1% of the dredged material is fine enough to remain in suspension following disposal, the Corps estimates that disposal of construction-related dredging will contribute up to 180,000 cy of suspended sediments over the two-year construction period.

Background suspended sediment loads for the same two-year period have been estimated at four mcy. The Project would have a maximum increase of 4.5% in the suspended sediment load and generally equates to less than one mg/L increase in suspended sediment concentrations. It is likely that these volumes will have limited influence on accretion and erosion in important salmonid habitat areas.

Contaminants associated with dredged and disposed sediments may be resuspended in the ecosystem. Contaminants are discussed in section 6.4.2, below. However, much of the material to be dredged from the navigation channel will originate from existing sand waves, a dynamic natural feature of the river bottom, that are constantly on the move due to current action. These sand waves contain a small percentage of fine sediments and organic material, thus have the potential to carry a limited amount of contaminants into natural resuspension from current action or dredging and disposal.

Dredged materials from Project berth areas are higher in silts and clays, and may have higher potential to create suspended sediments while dredging is occurring, as well as higher potential for associated contaminant resuspension. Materials resuspended by dredging and disposal activities may accumulate within the ETM, and be redistributed into lateral habitats of importance to salmon. The effects of the deposition of additional fine sediments into lateral habitats may be beneficial to those habitats, or detrimental due to the presence of contamination. Resuspension of contaminants related to the Project are further described below. Interrelated and/or interdependent activities, such as deepening of adjacent ports and berths can also have similar influence on suspended sediments. Ship wakes, interrelated to the Project, will cause limited increases in suspended sediment, however, the deepened channel may result in less ship traffic and overall less ship wake-induced suspended sediment.

NMFS believes that Project-related changes to suspended sediment could affect the habitat-forming process of sediment accretion and erosion. The Project-related addition to the suspended sediment load may result in a limited increase in accretion of sediment in lateral habitat areas. However, it is unlikely that this Project effect will have any significant benefit to habitats used by ESA-listed salmonids. As noted above, the effect of turbidity increases from Project activities is discussed in section 6.2.2.3, below.

Ecosystem Indicator - Bedload (including an analysis of accretion and erosion). Riverbed side-slope adjustments and some shoreline erosion are predicted to alter the accretion and erosion patterns within shallow water and flats habitat in the Lower Columbia River at five locations – RM 99, 86, 75, 72, and 46 through 42. A single location in the estuary, RM 22.5, is projected to experience riverbed side-slope adjustments. These six locations are all historic dredge material disposal sites, and provide limited salmonid habitat.

The side-slope adjustment process will take five to ten years to occur after construction. Over that time, shallow water and flats habitat at six shoreline disposal sites will tend to erode toward the shoreline and become deeper. The Corps determined that side-slope adjustments will not occur in natural shoreline areas because these riverbanks are stable, indicating that it is unlikely that tidal marsh and swamp habitat would be affected by side-slope adjustments. The Corps proposes to monitor for any impacts from side-slope adjustments to riparian habitats, including tidal marsh and swamp habitat. This information will enable the Corps and NMFS to track and react to potential changes in side-slope adjustment.

Sand from upstream areas is one of the sources of material for habitat-forming processes (accretion) in the estuary. This sand is important to the formation of tidal marsh and swamps and shallow water and flats habitat. The removal of sand from the river via dredging and upland disposal will not alter the ongoing, natural sediment transport process towards the estuary. The volume and rate of the bedload movement is not expected to change with Project activities. The volume of sand to be dredged over the life of the Project represents a small fraction of the total volume of sand in the riverbed. In addition, transport potential, rather than sand supply, is the limiting factor in sediment supply to the estuary. Therefore, it is likely that the impact to bedload processing of sand removal associated with the Project will be of a limited nature.

NMFS believes that Project-related effects to bedload may alter potential habitat for ESA-listed salmonids at one estuarine and five riverine sites. Predicted side-slope adjustments could harm these species' aquatic habitat by alteration of shallow water, shoreline habitat. Shoreline habitats provide important feeding and rearing areas for these species, therefore any effects to these habitats, above those effects or locations predicted in the 2001 BA, are important to monitor and address.

However, these six shoreline sites are highly erosive and unstable, and do not provide high quality habitat for ESA-listed salmonids. Additional effects discussion regarding side-slope adjustment is provided in section 6.3, below.

Ecosystem Indicator - Turbidity. Turbidity affects the ability of light to penetrate into water, and in turn, affects the amount of plant growth that can occur. This is important for habitat development, particularly in the shallow water areas, because the plant growth adds stability and reduces the chance for erosion. Turbidity plumes resulting from Lower Columbia River and estuary dredging and disposal occurs in a "near field" area (Carlson *et al*., 2001).

Increased turbidity from these Project activities are below the known turbidity levels that stimulate avoidance response by juvenile salmonids, as identified by Servizi and Martens (1992).

Some temporary and localized changes to river and estuary turbidity levels are anticipated to occur from the Project. Localized turbidity levels from Project construction and maintenance activities, five to 26 NTUs above background levels, are not likely to produce detectable effects on plant growth in the lower river or estuary. Increased turbidity will be localized to deep water areas where dredging and in-water disposal will occur. These limited increases to Columbia River and estuary turbidity levels will occur in deeper water areas where the majority of ESA-listed salmonids' migration and feeding activities are not occurring. Local turbidity increases in shallow water areas will occur during shoreline disposal. Ocean disposal will result in localized and short-lived periods of increased turbidity. While high levels of turbidity are known to affect salmonid physiology and feeding success, the combined background and Project-related turbidity concentrations within the action area are expected to generally remain well below known salmonid impact levels (*see* 2001 BA Sections 4 and 6.1.4). Any project-related turbidity increases should be limited to the immediate vicinity of the dredge cutterhead or draghead.

Ecosystem Indicator - Salinity. The concentration of salinity in important habitat and rearing areas of the estuary and the longitudinal gradient of salinity between the freshwater and ocean environments that bound the estuary are important to salmonid growth and survival. The Project will change the estuary's cross-sectional profile and have associated effects on estuary salinity gradients. Based on the WES RMA-10 and OHSU/OGI modeling, the largest Project-related impacts on salinity profiles occur at the lowest river flow analyzed (70,000 cfs).

In shallow areas of Cathlamet Bay and Grays Bay, where important juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted a post-Project salinity increase of 0.1 to 0.15 ppt. The OHSU/OGI model confirmed these predictions. Within the deeper navigation channel, where limited juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted post-Project salinity increases in the range of 1.0 to 1.5 ppt. The OHSU/OGI model confirmed these findings, but predicted slightly larger increases in salinity than those predicted by WES RMA-10 modeling for Youngs Bay and along the Oregon side of the navigation channel up to Tongue Point.

Modeling runs for higher river flows indicated even smaller post-Project salinity increases in important salmonid habitats. The OHSU/OGI model also was used to determine if, post-Project, there would be a significant change in habitat opportunity, as defined by Bottom *et al*. (2001) and the SEI workshop process. Using the OHSU/OGI model an example of the potential changes to habitat opportunity was developed by modeling Cathlamet Bay for five, one-week model simulations (*see* Table 6-1 of the 2001 BA). The model predicted, for important, shallow water Cathlamet Bay salmonid habitats, there was virtually no difference in the habitat opportunity, pre- and post-Project, for salinity between 0-5 ppt.

Changes to the ETM can effect phytoplankton, nutrient cycling, and availability of salmonid prey primarily within the estuary. Changes in salinity as a result of the Project could result in a permanent shift in the boundaries of the ETM, of up to one mile upstream This upstream movement will affect the location where imported phytoplankton die, and with other accumulated organic matter, are cycled through the estuary system. A change in the location and range of the ETM may affect the distribution of nutrients and thereby the location and abundance of salmonid food in shallow water habitats.

While it is believed salmonids do not feed in the ETM, nutrient cycling from the ETM may transfer to shallow water habitats and to the food items which juvenile salmonids prey on. No change in type or quantity of imported phytoplankton is anticipated in the short-term, and short-term effects to salmonids from predicted shifts in ETM, and subsequent modification in nutrient cycling, is anticipated to be limited. However, long-term impacts of the predicted shift in the ETM, based on potential changes to phytoplankton and nutrients (*see* Table 7-1 of the 2001 BA) over the Project's life are uncertain. NMFS believes the Corps' proposed Columbia River ETM workshop should enhance the understanding of the ETM and its influence on estuary ecosystem function. NMFS expects workshop findings will be discussed within the adaptive management process for the Project. Project modifications will then be implemented, as necessary, to minimize Project-related effects to the ETM.

Ecosystem Indicator - Bathymetry (including an analysis of velocity field). Bathymetric changes will occur in and beside the navigation channel. Dredging will lower the riverbed by three feet, in and beside the navigation channel. Long-term riverbed adjustments will occur on adjacent side slopes (*see* section 6.2.2, above). Within the riverine areas, 60% of the navigation channel will require deepening, whereas only 45% of the navigation channel in the estuary reach will require dredging. In-water and shoreline disposal of dredged materials will cause bathymetric changes by raising river and ocean bed elevations at disposal sites.

The deepened navigation channel will result in a small effect (decrease of up to 0.18 feet) on Columbia River water surface elevations in the upper Project area; an essentially immeasurable decrease (0.02 feet) in water surface elevation in the estuary; and no water surface elevation change in the river mouth reach. Of all ESA-listed salmonids, only Columbia River chum salmon spawning habitat occurs in the Project area. However, these water surface elevations should not impact existing habitats (*e.g.*) spawning and/or rearing, or reduce salmonids' ability to access those habitats.

Water surface elevation reduction would have limited effects on salmonid spawning and survival of eggs in redds upstream from the I-205 Bridge, and minimal impact on juvenile salmonid accessibility to shoreline habitats throughout the Project area. Also, within the upper river portion of the Project, lower water levels may allow marsh progradation (*i.e.*, building out) waterward of the marsh. The OHSU/OGI model evaluated pre-and post-Project water depth differences in terms of hours of habitat opportunity. The model outputs for important, shallow water Cathlamet Bay salmonid habitats, are nearly identical for pre- and post-Project water depths, indicating effects of the proposed action on the water depths will have a limited impact on habitat opportunity.

Changes in bathymetry from dredging and disposal may change river velocity, and thereby affect habitat opportunity. The WES RMA-10 modeling results indicated that average pre- and post-Project velocity differences are small, ranging from approximately -0.2 foot per second to 0.2 foot per second. The largest velocity differences were noted in the navigation channel.

Pre- and post-Project velocity differences in shallow salmonid habitat areas outside the navigation channel ranged from approximately -0.05 to 0.05 foot per second. OHSU/OGI modeling supports these results. The post-Project velocities are well within the range of favorable velocities identified for juvenile salmonids, as defined by NMFS (Bottom *et al*. 2001). The OHSU/OGI model evaluated pre- and post-Project velocity magnitude differences in terms of hours of habitat opportunity. Modeling results were done for vertically-averaged water column velocities and for minimum and maximum water column velocities. Both the spatial distributions and the area-weighted averages for water column velocity were similar for pre- and post-Project. Maximum differences in average hours of approximately 10 to 15% (increase and decrease) between base and plan were predicted for model runs at both low and high flow. In these cases, the model runs for the post-Project scenario estimated higher habitat opportunity hours than the environmental baseline.

Based on the impacts to water depth-associated habitat opportunity, NMFS concludes that there will be limited, short-term effects on feeding habitat opportunity or refugia for yearling and older salmonids. In particular, the changes in water surface elevations projected within the estuarine and riverine reaches are not likely to alter the amount or location of refugia. In addition, changes to river current velocity from the proposed dredging are anticipated to be small (particularly in the side channels and shallow water areas that provide the refugia) and will not affect the function of the available refugia. This is because yearlings are commonly found in areas of both low and relatively high current speeds as they rapidly migrate downstream. Generally, yearlings are not strongly shoreline-oriented, although some are found in shoreline areas.

In addition, yearlings tend to be surface-oriented, but feed over a relatively wide range of depths, from the surface up to five to ten meters deep. For subyearling fish, changes in refugia and feeding habitat opportunity may be more pronounced. While short-term impacts appear to be unlikely, the long-term impacts to habitat opportunity and refugia over the Project's life from these limited bathymetric and hydraulic changes cannot be quantified and are therefore uncertain. Any long-term, negative changes in bathymetric or hydraulic conditions may harm these species' aquatic habitat, thereby negatively effecting refugia and habitat opportunity for these species. Therefore any effects to these habitat conditions, above those effects or locations predicted in the 2001 BA, are important to monitor and address via the adaptive management process.

6.3 Effects from Construction and Maintenance Activities on Key Salmonid Habitats

During the course of this reinitiation of consultation, much discussion centered around the potential effect of construction and maintenance activities on tidal marsh and swamp, shallow water and flats, and water column habitats. The conceptual ecosystem model identified these habitat types as particularly important to juvenile salmonids residing in the estuary. Thus, NMFS has focused on these habitat types in its effects analysis. Below is a detailed examination of these three key habitat types, and the Project-related effects to them.

6.3.1 Tidal Marsh and Swamp

Tidal marsh and swamp habitat occurs sporadically along the margins of shallow water areas of the Columbia River and estuary, with these habitats' most concentrated occurrence in the estuary and downstream portions of the riverine reach. Ocean-type Chinook and chum salmon commonly use these habitats, and stream-type salmonids also will use these habitats during their shorter occupancy periods.

No dredging within the tidal marsh and swamp habitat is planned. Likewise, no filling of tidal marsh and swamp habitat is proposed as a part of the Project. NMFS, in analyzing potential Project effects to tidal marsh and swamp, focused on the habitat-forming processes of salinity and bathymetry that may affect tidal marshes and swamp habitats.

Based on the WES RMA-10 and OHSU/OGI model outputs, the post-Project salinity distribution is unlikely to change within shallow water estuary areas, where much of the tidal marsh and swamp habitat is located. In addition, even if larger post-Project salinity changes occur in the estuary, the dominant marsh plants found in these habitats exhibit wide salinity tolerances. In upriver areas, tidal marsh and swamp habitats will not be influenced by any post-Project changes to salinity distribution, as these habitat features are upstream from salt water influence.

The other major habitat-forming process that may influence tidal marsh and swamp habitat is bathymetry. Predicted post-Project water surface elevation changes range from zero to -0.18 foot, with the smallest elevation changes predicted in the estuary and lower river areas. In fact, tidal marsh and swamp habitat may increase slightly in upriver Project areas as a result of the channel deepening. The predicted decrease in water surface elevation in upriver areas may provide more shallow water habitat that is at the appropriate depth for tidal marsh to develop. This would allow tidal marshes to establish or expand, and may lead to a long-term, small increase in tidal marsh habitats.

Side-slope adjustments are not expected to occur in natural shoreline areas because these areas are stable, indicating that it is unlikely that tidal marsh and swamp habitat would be affected by post-Project side-slope adjustments. The Corps proposes to monitor for any impacts from side-slope adjustments to riparian habitats, including tidal marsh and swamp habitat. This information will enable the Corps and NMFS to track and react to potential changes in side-slope adjustment.

The following are the two specific environmental indicators that could be affected by changes to tidal marsh and swamp habitats:

<u>Insects</u>. Terrestrial insects that form part of the prey base for juvenile salmonids include larval forms, as well as adults. Insect larvae and some adults are often found in the stomachs of salmonids that feed in shallow flats and marsh channels. Salinity intrusion, associated primarily with the main channel, is not expected to change the abundance of insects that are primarily along the water margins in shallow wetlands and marsh channels.

Short-term impacts to insect abundance and diversity are likely to be limited. Based on Table 7-1 of the 2001 BA, the uncertainty and risk of impact to insect production and salmonid food availability, although potentially limited, is uncertain in the long term. Long-term monitoring, as recommended above for areas of side-slope adjustment, will provide information on Project-related effects to insect production.

Macrodetritus and Microdetritus. The production of prey resources important to juvenile salmonids is partially supported by marsh detritus. Resident microdetritus, which is derived from benthic and planktonic algal production, is important to suspension feeders and suspension/deposit feeders. Imported microdetritus is mostly derived from algal production upriver, including that produced above dams. As a primary producer, it is an important food source for suspension feeders and suspension/deposit feeders that form part of the prey base for juvenile salmonids.

The proposed dredging action is not likely to have an effect on the amount or productivity of tidal marsh macrodetritus or microdetritus. This is because no dredging or disposal within the tidal marsh and swamp habitat is planned.

Due to the predicted lowering of water elevation in the upper portion of the Project area, the amount and characteristics of tidal marsh and swamp habitat could result in limited expansion along the shallow water margins of the upper Project area. Increased macrodetritus and microdetritus production may occur from limited marsh expansion upstream from RM 80. Due to the predicted upstream shift of the ETM, there may also be a limited shift in the extent of resident and imported microdetritus food web input. The Project may also result in a small shift in the location of where resident microdetritus dies. Thus, short-term impacts to macrodetritus and microdetritus are likely to be limited. Based on Table 7-1 of the 2001 BA, the risk and uncertainty to this indicator suggests the limited nature of this expansion will have an uncertain benefit to ESA-listed salmonids in the long term.

Tidal Marsh and Swamp Summary. NMFS anticipates negative short-term Project-related effects to tidal marsh and swamp habitats will be limited. As described in the SEI risk assessment, long-term Project effects to tidal marsh and swamp habitats are of moderate uncertainty to occur, but have a low risk to impact habitat (*see* 2001 BA, Table 7-1). Any long-term, negative changes in tidal marsh or swamp habitat may harm ESA-listed salmonids feeding and refugia needs. Therefore, any effects to these habitat conditions above those effects or locations predicted in the 2001 BA will be monitored and addressed over the Project life.

6.3.2 Shallow Water and Flats

Shallow water and flats habitats provide important feeding and rearing areas for ocean-type, ESA-listed salmonids. Stream-type juveniles may also potentially use shallow water and flats habitat within the Lower Columbia River and estuary during their shorter occupancy periods. In addition, adult chum salmon use shallow water habitat for spawning in the riverine reach upstream from the I-205 Bridge. NMFS, in analyzing potential Project effects to shallow water and flats habitats, focused on Project-related effects from side slope adjustments after channel dredging and after shoreline disposal, and also reviewed Project effects to ecosystem indicators that would respond to changes in shallow water and flats habitat.

The entire post-Project navigation channel may experience side-slope erosion and subsequent adjustment of side-slope angle. The erosion and adjustment will, over five to ten years, lower the adjacent riverbed angle until a new, more stable side-slope is established. While side-slope adjustments will occur throughout the Project area in deeper water, where minimal salmonid habitat use is known to occur, some side-slope adjustment will occur in shallow water and flats habitats.

The Corps predicts shoreward erosion from side-slope adjustment to occur in a total of six sandy beach areas: five in the Lower Columbia River (RM 99-86, 75, 72, and 46-42) and one in the estuary (Miller Sands Spit). These areas have shallow water habitats that could be used by salmonids, however, the Corps indicates these are highly erosive areas that have little productivity.

NMFS believes that, even though each of the six sandy beach sites may experience ten to 50 foot lateral erosion into the sandy shoreline, minimal impact to salmonids or their shallow water habitat will occur. As noted in section 6.2.2, above, predicted side-slope adjustments will affect habitat for ESA-listed species by alteration of these six areas with shallow water, shoreline habitat. Shallow water habitats provide important feeding and rearing areas for ESA-listed salmonids, therefore any effects to these habitats, above those effects or locations predicted in the 2001 BA, will be monitored and addressed. However, these six shoreline habitats are highly erosive and unstable, and do not provide high quality habitat for these species.

Shoreline disposal could potentially disturb and shift the location of shallow water habitat at three proposed shoreline disposal sites. No salmonids will be injured during shoreline disposal activities, as dredged materials are discharged above the water line. Therefore, NMFS' analysis focused on the potential for disturbing salmonids that use existing shallow water habitat within these areas. The three shoreline disposal locations have steep side slopes (around 10%) that provide about seven acres per mile of shallow water areas. Shoreline disposal will affect a total of about 4.5 miles or 30 acres of shallow water. While 30 acres of shallow water habitats will be periodically impacted during the Project life, the three disposal sites are all highly erosive and do not contain many of the important habitat features that shallow water habitats typically include, such as low velocity, vegetation, and food sources. These sites had previously been approved by NMFS for shoreline disposal because of their low productivity.

The following is the one specific environmental indicator that could be affected by changes to shallow water and flats habitats:

Benthic Algae. Benthic algae consist primarily of benthic diatoms that occur on sediment grains and larger inorganic material and on macrophytes as epiphytes.

There will be no dredging in the shallow flats and channels where benthic algae primarily occur. Flowlane disposal is not expected to affect benthic algae because it is done below the depth range where benthic algae occur, about 1 meter below MLLW. No dredging or disposal activities are proposed for areas with significant benthic production. The closest potential effect would be from the shoreline disposal at Sand Island (O-86.2). However, the existing currents and erosion rates at the beach nourishment site create a coarse-grained and erosive environment that severely limits the potential for significant benthic production. Accordingly, no effects to benthic production are anticipated in the riverine reach.

Modeling by OHSU/OGI and WES predicts an upstream shift of salinity of less than a mile. Accordingly, there may be an upstream shift in the location of benthic algae production. Any salinity change would occur primarily in the navigation channel, not in productive side channels or lateral habitats. Thus, short-term impacts to benthic algae are likely to be limited. However, long-term Project-related indirect impacts are uncertain (*see* Table 7-1 of the 2001 BA). NMFS believes long-term risk to food web production for ESA-listed species, based on changes to benthic algae production, is limited.

Shallow Water and Flats Summary. NMFS anticipates that negative short-term Project-related effects to shallow water and flats habitats will be limited to areas of side slope adjustment and shoreline disposal. Long-term Project effects to shallow water and flats habitats are of moderate uncertainty, to occur with low to moderate risk to impact habitat (*see* 2001 BA, Table 7-1). Any long-term, negative changes in shallow water and flats habitat may harm benthic production, feeding, migration, and refugia needs for ESA-listed salmonids. Therefore any effects to these habitat conditions, above those effects or locations predicted in the 2001 BA, will be monitored and addressed through the adaptive management process.

6.3.3 Water Column

The upper portion of water column habitat is used for salmonid movement, migration, and feeding. Deeper water column habitat in the Lower Columbia River, estuary and river mouth is less used by salmonids, with water deeper than 20 feet believed to be rarely used. Water column habitat beside the navigation channel, turning basins, and berths will be directly increased to no more than 48 feet deep. The Project may affect water column habitat by short-term blasting activities, by temporary water clarity reduction during dredging and flowlane disposal activities, and by long-term changes in estuary salinity distribution and ETM range.

Blasting will be done once during Project construction, and will occur only during the in-water work window. Blasting may have direct effects to salmonids, and was discussed in section 6.2.1 of this Opinion. Blasting only during the in-water work window minimizes, but does not avoid, direct impacts to ESA-listed salmonids, which may use the Warrior Rock area year-round. As noted in section 6.2.1 above, NMFS believes that development of a NMFS-approved monitoring plan, that ensures that the proposed blasting measures are implemented, will be important to minimize any injury or death to these species during blasting activities.

Temporary water clarity reductions will occur from dredging and disposal activities. A proposed impact minimizing action will require all in-water disposal activities, except shoreline disposal, to occur below 20 feet in depth, where less salmonid use occurs. As noted in the turbidity discussion above, these temporary turbidity increases will not decrease plant growth and subsequent habitat forming processes, nor are the Project-related turbidity levels anticipated to impact salmonid physiology or feeding (*see* 6.2.3, above). Project construction and maintenance activities may occur outside of the normal November 1 to February 28 in-water work period. Therefore increased turbidity may occur during periods of highest salmonid abundance in the Project area. Juvenile salmonids occur primarily at depths shallower than 20 feet, and so would not be expected to be impacted by turbidity from dredging and disposal operations. NMFS believes these slight increases to Columbia River and estuary turbidity levels will occur in deeper water areas where the majority of ESA-listed salmonid migration and feeding activities are not occurring. Therefore, the ESA-listed salmonids should experience only limited harassment from increased water column turbidity.

As noted in the ETM and salinity discussions above, the WES RMA-10 and OHSU/OGI models predicted that there was virtually no difference in the habitat opportunity (*i.e.*, salinity "accumulation") between pre- and post-Project modeling runs for important shallow water Cathlamet Bay salmonid habitats. However, a shift in the location of the ETM would occur and may affect the estuarine distribution of nutrients and thereby the location and abundance of salmonid food in shallow water habitats. The risk and uncertainty to the ETM, based on changes in salinity (Table 7-1 of the 2001 BA), is low in the short term, but more uncertain in the long term because of extrapolating modeling results over the life span of the Project.

The following three specific environmental indicators: (1) Deposit feeders, suspension-deposit feeders, and suspension feeders; (2) mobile macroinvertebrates; and (3) phytoplankton could be affected by changes to water column habitats.

Deposit Feeders/Suspension-Deposit Feeders/Suspension Feeders. Limited removal of organisms via dredging and burying of deposit feeders, suspension/deposit feeders, and suspension feeders will occur in portions of the navigation channel deep water areas and the three shoreline disposal sites. Flowlane disposal will bury some animals and, if deposition of sediments is heavy, will result in the partial loss of some communities. Removal and burial effects are expected to be relatively short-lived, with dredge and disposal areas being recolonized by deposit feeders. Deposit feeders occur in low densities in the navigation channel because the sand waves create constantly shifting habitat conditions. In these and other areas of the river, densities fluctuate as a result of constantly changing environmental conditions. No changes to deposit feeders are anticipated in shallow water areas, side channels, or embayments, which are the important locations for salmonid feeding opportunities. Other than the low risk identified to deposit feeders in the bottom of the navigation channel, Table 7-1 of the 2001 BA suggests that the long-term changes from dredging and disposal to deposit feeders, suspension/deposit feeders, and suspension feeders is uncertain. Because deposit feeders, suspension/deposit feeders, and suspension feeders are prey items for ESA-listed salmonids, any removal of these organisms via dredging or disposal may cause short-term harm to these fish species. However, because the loss of food items is limited, will not occur in the most important habitat types, and these invertebrates recolonize dredge and disposal locations rapidly, NMFS believes the potential for such harm is minimal.

Mobile Macroinvertebrates. Dredging will result in removal of mobile macroinvertebrates in the channel. Entrainment by dredges is likely lethal to macroinvertebrates. In addition, flowlane disposal may temporarily bury some animals and, if deposition of sediments is heavy, will result in the loss of some members of the group. Removal and burial effects are expected to be relatively short-lived, with dredged areas being recolonized within six to 12 months (Flemmer, *et al*., 1997). Mobile macroinvertebrates in shallow water, flats, and tidal marsh channels are not likely be affected. ESA-listed salmonids may feed on certain mobile macroinvertebrates, and therefore any loss of these prey items via dredging or disposal may harm these species. However, NMFS anticipates this harm from dredging or disposal to be localized to areas of low importance to these species.

Mobile macroinvertebrates in the estuary appear to be adapted to respond rapidly to disturbances and can recolonize areas following these disturbances. Due to this group's wide salinity tolerance, Project-related changes in estuary salinity are not expected to have an effect on the distribution of mobile macroinvertebrates. In addition, since Project-related temperature and suspended sediment changes are not anticipated or will be limited in nature, mobile macroinvertebrates should not be influenced by limited Project-related changes to these indicators.

Phytoplankton. Because salinity may intrude farther into the estuary as a result of the deeper channel depth, the point where imported phytoplankton contact dilute seawater will be farther upstream from current conditions. Predicted changes in salinity intrusion may affect the location of resident phytoplankton productivity. Based on Table 1 of the 2001 BA, the short-term impacts to imported and resident phytoplankton productivity changes are likely to be limited, and will not harm ESA-listed species. However, long-term impacts over the Project's life, based on the BRT's risk and uncertainty analysis, are uncertain.

Water Column Summary. NMFS anticipates that negative, short-term Project-related effects to water column habitats will be limited to blasting areas and areas where in-water disposal is occurring, and to ecosystem indicators associated with inwater disposal. NMFS believes that development of a NMFS-approved monitoring plan that ensures that the proposed blasting measures are implemented, will be important to minimize any injury or death of ESA-listed salmonids during blasting activities. NMFS believes that only limited harassment from increased water column turbidity will occur to ESA-listed salmonids. Removal of deposit feeders, suspension/deposit feeders, suspension feeders, and mobile macroinvertebrates via dredging or disposal activities may cause short-term harm to ESA-listed salmonids. Long-term Project effects to water column habitats are of moderate uncertainty, with low risk to adverse habitat modification (*see* 2001 BA, Table 7-1). Any long-term, negative changes in water column habitat may harm feeding, migration, and refugia needs of ESA-listed salmonids. Therefore, any effects to these habitat conditions, above those effects or locations predicted in the 2001 BA, are important to monitor and address via the adaptive management process.

6.4 Indicators that Occur in More Than One Key Habitat Type

6.4.1 Habitat Complexity, Connectivity, and Conveyance; Feeding Habitat Opportunity; Refugia; and Habitat-specific Food Availability

In discussion associated with this consultation, consideration was given to whether the proposed Project has the potential, based on post-Project changes in water surface elevation, velocity, and salinity intrusion, to change habitat complexity, connectivity, or conveyance; feeding habitat opportunity; refugia; and habitat-specific food availability associated with tidal marsh and swamps and shallow water and flats habitat areas. These are indicators that may respond to Project-related changes in any of the key habitat types, and therefore reflect an ecosystem approach to impact assessment.

The Corps undertook modeling to examine the potential Project effects on habitat opportunity and key habitat types from changes in water surface elevation, velocity, and salinity intrusion. The OHSU/OGI and WES RMA-10 modeling results indicate slight changes to water surface elevation, velocity, and salinity intrusion. Within Cathlamet and Grays Bays' tidal marsh and swamps and shallow water and flats habitat habitats, modeling predicted post-Project salinity increases of 0.1 to 0.15 ppt, velocity decreases of 0.05 feet per second, and depth changes of less than 0.02 feet. Habitat opportunity, based on a combined analysis of these indicators, shows no significant difference between pre- and post-Project conditions in tidal marsh and swamps and shallow water and flats habitats. The OHSU/OGI modeling also related these physical parameters to the concept of habitat opportunity (*see* Bottom *et al*., 2001). In the modeling example provided by OHSU/OGI, navigation channel improvements are predicted to result in a limited change in habitat opportunity hours for Cathlamet and Grays Bays, based on the depth and velocity criterion and salinity "accumulation."

The two indicators most related to habitat opportunity are feeding habitat opportunity and refugia (*see* Chapter 5 of the 2001 BA). Additional indicators related to habitat opportunity are habitat complexity, connectivity, and conveyance, and habitat-specific food availability. Based on the limited impacts indicated by the OHSU/OGI habitat opportunity modeling results, NMFS believes the Project will have limited short-term effects on tidal marsh and swamps and shallow water and flats habitat habitats. Limited effects to these key habitats should result in limited effects to associated habitat complexity, connectivity, and conveyance; feeding habitat opportunity; habitat-specific food availability; and refugia for ESA-listed salmonids. NMFS anticipates limited harm to ESA-listed salmonids from changes to habitat opportunity and associated indicators.

Model-generated estimates of habitat opportunity provide an indication of limited change to depth, velocity, and salinity within key habitat types (tidal marsh and swamps and shallow water and flats habitat habitats), but do not predict response by key habitat or other related indicators' to Project-related changes in depth, velocity, and salinity over the long term. This fact, combined with the risk and uncertainty indications provided in Table 7-1 of the 2001 BA for habitat opportunity-related indicators, suggest that the long-term impact to these indicators is uncertain. NMFS believes any effects to these habitat conditions, above those effects predicted by modeling or presented in the 2001 BA, are therefore important to monitor over longer time scales and address via adaptive management.

6.4.2 Contaminants

Dredging and in-water disposal activities in the navigation channel turning basins and berths, and in-water disposal activities in the ocean, along with other natural and anthropogenic processes, could expose salmonids to some contaminants. Of particular concern is resuspension of persistent organochlorine contaminants including total polychlorinated biphenyls (PCBs) and the pesticide DDT and its metabolites DDE and DDD ($\sum$DDTs), which have bioaccumulated in resident fish and wildlife within the estuary (*see* terrestrial species Opinion for further description of these concerns). In addition, petroleum compounds, characterized as total polyaromatic hydrocarbons (PAHs), have been identified in Lower Columbia River sediments. The organochlorine and PAH contaminants have the ability to impact growth, survival, and reproduction of juvenile salmon and trout, and can cause sublethal effects such as immune dysfunction (Arkoosh *et al*. 1991; *see also* 2001 BA, Appendix B for further discussion of lethal and sublethal impacts of these chemicals on salmonids). Data collected by NMFS indicate that juvenile salmonids within the Columbia River estuary have contaminant body burdens that may already be within the range where sublethal effects may occur, although the sources of exposure are not clear (NWFSC Environmental Conservation Division, 2001).

Data are sparse regarding the exact pathways for uptake and bioacumulation of contaminants by juvenile salmonids in the Lower Columbia River, or the relationships between sediment and tissue contamination (2001 BA Appendix B for identification of specific pathways for salmonids). Recent studies suggest that sediments are a major source of hydrophobic contaminants to aquatic biota (Zaranko *et al*., 1997, Maruya and Lee, 1998). In sediments, contaminants are adsorbed to the organic carbon in silt, which is part of the fine particulate fraction. The microbial biofilm that accumulates on the surface of organic particles constitutes the food of certain types of epibenthic invertebrates; together they make up the pathway by which these contaminants enter food chains involving juvenile salmonids. Thus, juvenile salmonids bioaccumulate organochlorine contaminants and PAHs principally from their food (*i.e*., epibenthic prey species) as opposed to water. NMFS has documented some contaminants in the epibenthic prey species of juvenile salmonids in the Lower Columbia River (NWFSC Environmental Conservation Division, 2001).

In order to adequately address the potential contaminant-related impacts from Project activities, it is important to assess the amount of fine-grained (and thereby potentially-contaminated) material retained in the estuary following dredging and disposal activities. According to the 2001 BA, the Columbia River navigation channel is dominated by coarse-grained materials (primarily sand) with very low organic carbon, although pockets of fine materials are occasionally encountered, such as within the turning basin at Astoria, Oregon. The navigation channel is characterized by sand waves along the riverbed that move downstream. As the downstream sand movement occurs, bedload transport erodes sand from the upstream face, deposits in the downstream trough, and then buries it with more sand eroded from the upstream face. This transport occurs in a layer only a few sand grains thick. The sand that forms the cutline shoals or sand waves is repeatedly re-exposed to the water column. Consequently, fine material mixed in with the sand is likely to be swept away as the layers are exposed to the river currents, resulting in the limited potential for release of fines during the dredging activity. The Corps employed a risk-based analysis (*see* Appendix B of the 2001 BA) to address the potential resuspension of contaminants (total PCBs, $\sum$DDTs, and total PAHs) produced by Project construction and maintenance activities. The results of the Corps' assessment concluded that contaminant concentrations in the navigation channel sediments posed only negligible risk to juvenile salmonids, whereas some nearshore sediments closest to point sources of contamination posed risks.

It is important to ensure that sufficient sediment samples are available to adequately characterize the nearshore and channel sediment. During their Sediment Quality Evaluation for the Project, the Corps reported 3 of 23 samples chemically analyzed within or near the navigation channel contained fine-grained sediments with detectable levels of DDT, DDE, DDD, and total PCBs. However, none of these samples exceeded DMEF or NMFS recommended contaminants thresholds. These data and other sediment data were evaluated in the risk assessment for salmonids (*see* Appendix B of the 2001 BA), which concluded that sediments from the navigation channel pose negligible risks to salmonids. However, this Appendix B conclusion was based on relatively few sediment samples collected within the navigation channel, especially below RM 40. The Corps has subsequently submitted additional analysis of all available sediment and contaminants data from the Columbia River navigation channel (Corps' April 22, 2002, addendum). The Corps has determined there are no navigation channel sediment and contaminants data which exceed current DMEF contaminants thresholds. These additional data also do not exceed NMFS' thresholds for PCB's (75 ng/g dry weight for 1% total organic carbon [TOC]) and PAH's (1,000 ng/g dry weight sediment) (NMFS' contaminants thresholds provided by Johnson, NMFS Northwest Fisheries Science Center, 2002).

Due to the highly erosive and dynamic nature of the navigation channel, described above, and based on the Corps' risk analysis results and information provided in the Addendum to the 2001 BA, NMFS believes it unlikely that any contaminants within the navigation channel would be present in high enough concentrations to expose and impact ESA-listed salmonids and bull trout. However, it is unknown how much fine material will be resuspended during Project dredging and disposal activities, or whether or not any of the fine material released would be contaminated. The general lack of organic material and very low organic carbon concentrations in the navigation channel sediments would likely result in rapid transfer of any available carbon and contaminants into salmonid tissues. Even low concentrations of bioaccumulative contaminates would be readily available to salmonids in this situation, and predators higher in the food chain, such as bald eagle, could be more at risk than salmonids. Therefore, NMFS believes additional navigation channel samples should be periodically collected, and all other new sediment quality data evaluated, on a regular basis during Project activities to better determine the distribution of fine materials, carbon, or contaminants within the navigation channel.

In summary, NMFS believes that dredging and inwater disposal activities associated with the Project could release a small amount of fine-grained sediments. It is uncertain as to whether most of these fine-grained sediments would be uncontaminated (due to the erosional forces within the main channel of the river), or if some of the fine-grained material would be associated with contaminants. In the high-energy environment of the navigation channel, any contaminated material would move rapidly through the system and be deposited outside the flow lane in depositional areas within the estuary, or be transported down the flow lane and into the ocean. Any contaminants that did reach riverine and estuarine depositional areas, combined with contaminants transported and deposited due to natural and other non-Project anthropogenic sources, would eventually be redistributed, resuspended, and transferred along the estuary and river food chain.

The contribution of Project activities to contaminant burdens in salmonids is not well defined and, as such, some uncertainty exists as to Project effects to ESA-listed salmonids. NMFS therefore supports implementation of the Corps' contaminants research activities ERA-4 and ERA-5, proposed in the 2001 BA (*see* Table 8-1) and monitoring action MA-5, proposed in the 2001 BA (*see* Table 7-3). However, NMFS believes estimated risk of exposure of ESA-listed salmonids from contaminated sediments from Project activities appears limited (*see* Appendix B of the 2001 BA).

6.5 Effects from Interrelated and Interdependent Activities

6.5.1 Willamette River Navigation Channel Deepening

More than 11 miles of the Willamette River are included in the Project authorized by Congress but are not analyzed in the 2001 BA or this Opinion. Concerns over Willamette River sediment contamination and uncertainty regarding the scope and timing of remedial investigations and actions caused the Corps to remove this portion from the proposed action. Potential effects from any future Willamette River Navigation Channel deepening activity cannot be determined, due to the unknown implications of Superfund cleanup and other remedial actions. If the Corps is to proceed with a Willamette River navigation channel deepening project in the future, the Corps will be required to review the additional effects of this future Federal action through a separate ESA consultation process.

6.5.2 Deepening and Maintenance of Project Berths

Construction and maintenance dredging at a total of seven Lower Columbia River berths, associated with three grain facilities, one gypsum plant, and one container terminal, represent actions that are interrelated and/or interdependent to the Project. However, this Opinion does not provide incidental take coverage for berth dredging, as these activities will undergo future ESA consultation. The future ESA consultation will initiate upon NMFS' receipt of applications for Federal permits, before berth-dredging activities.

Future berth deepening and maintenance activities are likely to have both direct and indirect impacts on listed-ESA salmonids. Direct effects include death or injury due to entrainment during dredging activities. Indirect effects include harm and harassment to ESA-listed salmonids via increased turbidity, loss of food resources, and resuspension of toxic sediments.

Effects from future berth deepening activities will be minimized due to application of dredging and disposal BMPs and other compliance measures (*see* Table 3.2 of this Opinion). Sediment testing, based on DMEF protocols, will ensure dredged materials from berths are disposed in the least impactful method. Additional sediment testing may be required, during additional consultations (*see* discussion of MA-5 in section 3.2.6 of this Opinion). Dredging activities will occur within the November 1 to February 28 inwater timing window, when ESA-listed salmonid abundance is lowest. Dredge activities will occur in deep water, where food resources are limited and most salmonids are not present. Finally, higher quality habitat, associated with key habitat types in the ecosystem conceptual ecosystem model, are not believed to occur at these existing berth features, and therefore impacts to these habitats will be avoided.

NMFS believes berth deepening and maintenance will have limited future adverse effects on ESA-listed salmonids. While some of these adverse effects can be successfully minimized by application of BMPs and compliance measures, a limited amount of harm and harassment of ESA-listed salmonids is likely to occur from berth deepening and maintenance activities. These berth deepening and maintenance activities will undergo future ESA analysis before berth dredging activities to address this incidental take of ESA-listed salmonids.

6.5.3. Development of Port Activities and Deep Draft Vessels

Based on the Corps' 1999 FEIS analysis, future development of other Lower Columbia River port facilities is not analyzed here as an interrelated or interdependent activity because such development will be caused by regional market factors such as commodity demand, not by channel improvements. The Corps' April 15, 2002, addendum further supports the Corps' FEIS conclusion that, aside from berth deepening, potential future port development is not interrelated or interdependent with the Project.

Impacts from interdependent ship wakes would occur only if the Project resulted in more frequent or larger, higher-energy ship wakes. Current impacts from shallow- and deep-draft ship traffic utilizing the 40 foot navigation channel are considered part of the environmental baseline and are not considered interrelated or interdependent to the Project; only future, Project-dependent ship traffic is considered in this analysis.

The Corps analysis of post-Project ship wake effects indicated that larger, fully-loaded ships would have a 1 to 5% increase in "blockage ratio" (indicative of slightly higher ship wake generation), whereas smaller vessels would have a 1 to 5% decrease in "blockage ratio" (indicative of slightly lower ship wake generation). NMFS concludes that these limited increases and decreases in post-Project ship wake are not likely to increase suspended sediment, shoreline erosion, or increase current rates of ship wake-induced salmonid stranding.

In summary, the Corps concluded in their 1999 FEIS that channel deepening will not induce additional ship traffic, or contribute to development of additional port infrastructure or new ports. This conclusion is consistent with historical vessel traffic trends on the Columbia River and with the market forces that drive port facility development.

6.5.4 Non-indigenous Species Introductions

Several non-indigenous aquatic species are believed to have been introduced into the Columbia River via ballast discharge (*e.g*., Asian clam). These non-indigenous species introductions may continue to occur from ongoing vessel traffic, regardless of the Project's deepened channel. Future deep-draft cargo vessel traffic, interrelated and/or interdependent to the deepened navigation channel, also may introduce additional non-indigenous species. Federal authority for management and regulation of exotic species via ship ballast resides with the U.S. Coast Guard. While NMFS believes additional non-indigenous species introductions could have detrimental impacts on Columbia River and estuary ecosystem resources, NMFS does not believe that new boat traffic, interrelated and/or interdependent to the deepened navigation channel, will increase the risk of introduced species above current baseline levels.

Additionally, no other non-Project activities within the Lower Columbia River, estuary or river mouth have been reviewed in this effects analysis. Therefore, any additional actions to deepen or otherwise improve adjacent port facilities not addressed in this Project consultation and conference, would be subject to separate environmental analysis and regulatory review.

6.6 Uncertainty Regarding Project-related Effects and Associated Risk to Ecosystem Indicators as Related to Monitoring Actions

The SEI panel suggested that scientific and management decisions involve a level of uncertainty related to environmental effects and associated risk to the ecosystem from those environmental effects. Uncertainty pertains to the amount of information available to predict a Project-related change to an indicator. For instance, if ample information for an indicator was available, the uncertainty associated with that indicator, in regards to potential Project effects, would be low.

For the purposes of this reinitiation of consultation, risk pertains to the level of threat to the survival or recovery of ESA-listed salmonids from Project-related changes to indicators. For instance, if salmonids are extremely sensitive to small changes in an indicator, then the risk associated with any Project-related changes to that indicator would be high. For purposes of the reinitiation process, including BRT analysis and deliberations, each conceptual ecosystem model indicator was evaluated to determine uncertainties and risk from implementing the proposed Project activities. That information is included in the 2001 BA (*see* Section 7.2), and is incorporated herein by reference.

As noted above in sections 6.2.2 - 6.5 of this Opinion, NMFS believes that Project-related indirect effects to ecosystem indicators will be limited. Key physical processes that likely will have limited changes during the channel construction process include suspended sediment, accretion/erosion, turbidity, salinity, bathymetry, and bedload. The short-term nature of these impacts was discussed during the SEI panel process and verified using the numerical modeling conducted by WES and OHSU/OGI. It should be noted that the levels of Project risk to ecosystem indicators were not high enough to require Project modification, but due to long-term uncertainties, were still of a level that warrants verification through monitoring.

Based on uncertainties regarding potential long-term Project effects and associated risk to salmonids, the Corps proposed a monitoring program (*see* Table 3.5 and section 3.1.6 of this Opinion). NMFS reviewed and commented on the monitoring program as it was developed during the BRT process. The monitoring program addresses the long-term ecosystem uncertainties and risk to the main ecosystem indicators and key habitat features (Table 6.1) addressed in sections 6.2 - 6.7. Monitoring results will be reviewed, and future changes to management will occur if adverse findings are determined.

Table 6.1 Pathways and Indicators to be Addressed by the Monitoring Program

Monitoring Action	Pathway	Indicators
Maintain three hydraulic monitoring stations to investigate pre- and post-Project relationships among flow, tide, salinity, water surface, and water temperature	Habitat-forming processes	Bedload; Salinity
	Growth	Habitat complexity, connectivity, and conveyance; Velocity Field; Feeding Habitat Opportunity
Compare actual to predicted sediment dredge volume	Habitat-forming processes	Bedload
Complete bathymetric surveys to track habitat alterations	Habitat-forming processes	Accretion/Erosion; Bathymetry
	Key Habitat Types	Shallow water/flats habitat
Aerial and ground mapping to track habitat alterations	Key Habitat Types	Tidal marsh and swamp habitat
	Food Web	Suspension/deposit feeders; Insects; Tidal marsh macrodetritus
	Growth	Refugia; Habitat-specific food availability
Review sampling needs for contaminants	Survival	Contaminants

Monitoring Action	Pathway	Indicators
Investigate pre- and post-Project salmonid stranding events	Survival	Stranding

6.7 Effects Resulting from Proposed Monitoring, Ecosystem Restoration, and Research Activities

The BRT identified the monitoring, research and ecosystem restoration components of the proposed action to verify assumptions, reduce scientific uncertainties and provide for long-term beneficial effects to ESA-listed salmonids and their important habitats. Substantial scientific information suggests that certain habitat types play a major role in the long-term viability of salmonid populations, including tidal marsh and swamp habitats, shallow water and flats habitats, and water column habitats. The Corps has therefore identified a number of restoration actions that have a high probability of enhancing the availability and productivity of these habitats for migrating salmonids through the action area. Nevertheless, the implementation of these restoration actions and the implementation of the monitoring and research actions will likely have short-term detrimental impacts of limited scope and duration.

This section reviews the effects of these components of the proposed action on ESA-listed salmonids. NMFS notes the difficultly of quantifying effects to ESA-listed salmonids from monitoring, research, and restoration actions, based upon available information, and further notes that much of the scientific emphasis during this reinitiation of consultation focused upon the effects of the navigation project upon habitat indicators and habitat forming processes that may be of significance to ESA-listed salmonids. The modeling efforts did not seek to directly quantify the long-term effects of these restoration or research activities on habitats of importance to ESA-listed salmonids. Hence, the effects analyses associated with these monitoring, restoration, and research activities are necessarily of a different and more qualitative nature than those associated with the navigation improvements.

6.7.1 Monitoring Program

Section 3.2.6 of this Opinion describes the elements of the comprehensive monitoring program that is part of the proposed action. Table 3.5 enumerates objectives of each element of the monitoring and their relation to the assumptions or predictions associated with this consultation. In Table 6.2, below, NMFS describes the anticipated effects of these monitoring activities. NMFS concludes that the adverse effects of implementing a monitoring program are likely to be limited, and will not cause take of ESA-listed salmonids.

Table 6.2 Proposed Project Monitoring Activities and Effects of Monitoring Program Implementation

Monitoring Activity	Anticipated Effects of Monitoring Program to Salmonids
Maintain three hydraulic monitoring stations: One downstream from Astoria, one in Grays Bay, and one in Cathlamet Bay. Parameters measured would include salinity, water surface elevation, and water temperature.	Over-water access to maintain monitoring stations should have minimal impacts to salmonids and their habitats.
Monitor annual dredging volumes from both construction and O&M activities.	None
Conduct main channel bathymetric surveys throughout Project area.	Over-water access to conduct bathymetric surveys should have minimal impacts to salmonids and their habitats.
Repeat estuary habitat surveys being conducted by NMFS.	Over-water and aerial access to conduct habitat surveys should have minimal impacts to salmonids and their habitats.
Review the SEDQUAL database and other available data to determine if there are areas that would require additional sampling. Review existing contaminants database using NMFS guidelines or trigger values that are more protective of salmonids and trout. Provide notification during construction dredging to monitor for presence of fine-grained material – *i.e.*, oily sheens.	Over-water access to conduct additional sediment surveys, and substrate-disturbing activities associated with additional surveys should have minimal impacts to salmonids and their habitats.
Monitor the incidence of stranding of juvenile salmon on beaches in action area. Field surveys will be made monthly at selected beaches (upper, mid, and lower river) during the April-August out-migration to measure the number of fish being stranded along beaches.	Over-water access to conduct salmonid stranding surveys should have minimal impacts to salmonids and their habitats. Handling of stranded salmonids is anticipated. Procedures for salvaging ESA-listed salmonids are provided in this Opinion's Incidental Take Statement.

6.7.2 Ecosystem Restoration Features

The Corps proposed several ecosystem restoration features to create or improve salmonid habitat, specifically tidal marsh/swamp and shallow water/flats habitat. It is important to emphasize that the ecosystem restoration projects identified below are not being proposed as Project "mitigation." These are restoration features being proposed under Section 7(a)(1) of the ESA to benefit the conservation of ESA-listed salmonids

A number of the new restoration features proposed by the Corps (Purple Loosestrife Control, Tenasillahe Island Interim and Long-term Restoration, and Bachelor Slough Restoration) occur in-water and have the potential, during implementation, to affect ESA-listed salmonids. The translocation of Columbian white-tailed deer to Cottonwood/Howard Island will have no effect on ESA-listed salmonids as the action is upland in nature. Two of the three original restoration actions identified in the FEIS (Columbia River Tidegate Retrofits and Walker-Lord and Hump-Fisher Islands Channel Connectivity Enhancements) occur in-water, so they also have the potential to affect ESA-listed salmonids. Other original FEIS restoration actions (*e.g*. Shillapoo Lake) are disconnected from ESA-listed salmonid habitats and will not have either beneficial or detrimental effects to ESA-listed salmonids. Section 8 of the 2001 BA and Chapter 4 of the Corps 1999 FEIS describe the proposed restoration features and their effects on ESA-listed salmonids. Both descriptions are incorporated here by reference. Subsequent modifications to these proposed restoration features are described below where applicable.

Lois Island Embayment and Millar/Pillar Habitat Ecosystem Restoration. In a letter dated November 13, 2003, to NMFS, the Corps explained that they will be unable to construct Lois Island Embayment and Millar/Pillar Habitat ecosystem restoration features due to Project modifications imposed by the state of Oregon as a result of their 401 certification and Coastal Zone Management Act review.

Purple Loosestrife Control. The original ecosystem restoration feature for purple loosestrife control included an integrated pest management approach using biological agents, herbicides, and mechanical control measures. Subsequent field review revealed the extensive distribution of purple loosestrife in the estuary and the physical difficulty of accessing the area, plus an increased knowledge of the plant's reproductive biology, has led to the conclusion that herbicides and mechanical control measures are inappropriate. Consequently, biological control through the release of up to four approved species of beetle will be utilized to address this invasive plant species and mechanical and herbicide control measure will be dropped from consideration. The four beetle species proposed for use as biological control agents (Table 6.4) are envisioned for distribution to control purple loosestrife, an invasive plant species, between RMs 18-52.

Table 6.3 Effects Summary

Feature	Area Affected by Restoration (acres) 2001 BA	Area Affected by Restoration (acres) Revised	Type, Function, and Value	Location	Disturbance During Construction	Incidental Take
Purple Loosestrife Control Program	300	300	**Type:** Tidal marsh and swamp **Function:** Maintain native tidal marsh plant community; increase detrital export **Value:** High	Throughout the Lower Columbia River	None	None
Tenasillahe Island Interim Restoration[1] (Tidegate/Inlet Improvements)	92	92	**Type:** Backwater/side channel reconnection to Columbia River **Function:** Increase access/egress for ocean-type salmonids **Value:** Moderate	Julia Butler Nation Wildlife Refuge Approximately RM 36	Less than four weeks of increased turbidity during construction	No adults, 36 juvenile salmon
Tenasillahe Island Long-Term Restorations[3] (Dike Breach)	1,778	1,778	**Type:** Tidal marsh and swamp; shallow water and flats habitat **Function:** Provide rearing habitat for ocean-type salmonids; increase detrital export **Value:** High	Julia Butler Nation Wildlife Refuge Approximately RM 36	To be determine during site specific ESA consultation	To be determined during site-specific ESA consultation
Bachelor Slough Restoration[4]	300 (instream restoration) 6 (shoreline) 27 (riparian restoration)	6 (shoreline)	**Type:** Shallow water and flats habitat; riparian forest **Function:** Provide rearing habitat for ocean-type salmonids; increase detrital export **Value:** Moderate (side channel); high (riparian forest)	Approximately RM 90	Less than four weeks of increased turbidity during construction	No adults 20 juveniles
Tidegate Retrofits for Salmonid Passage	38 miles	36 miles	**Type:** Tributary reconnection to Columbia River **Function:** Increase access/egress for ocean-type salmonids; improve access for adult salmonids to headwaters for spawning **Value:** High	Burris Creek-RM 81 Tide Creek-RM 83 Deep River-RM-22 Grizzly Slough-RM 29 Hall Creek-RM 27	Less than one week of increased turbidity for each location	No adults Burris Creek – 6 juveniles Tide Creek – 12 juveniles Grizzly Slough – 12 juveniles Deep River (3 sites) – 36 juveniles

Feature	Area Affected by Restoration (acres) 2001 BA	Area Affected by Restoration (acres) Revised	Type, Function, and Value	Location	Disturbance During Construction	Incidental Take
Walker/Lord and Hump/Fisher Islands Improved Embayment Circulation	335	335	**Type:** Marsh and swamp; shallow water and flats habitat **Function:** Provide rearing habitat for ocean-type salmonids; increase benthic invertebrate productivity **Value:** Moderate	Lord-Walker Approximately RM 62 Hump-Fisher Approximately RM 60	None	None
Cottonwood/Howard Island Proposal[2] Columbia White-Tailed Deer Introduction	1,000	1,000	Type: Translocation of Columbia white-tailed deer Function: Establish secure, viable subpopulation of Columbia white-tailed deer Value: High	Approximately RM 70	N/A	N/A

Notes: The Tidegate Retrofits for Salmonid Passage, Walker/Lord and Hump/Fisher Islands Improved Embayment Circulation, and Shillapoo Lake Restoration features were proposed in the original FEIS (Corps, 1999a). The remaining restoration features were added during the BA reconsultation process.
1This restoration is contingent on hydraulic analysis results.
2This restoration primarily benefits Columbia white-tailed deer.
3This restoration feature is contingent on the delisting of Columbia white-tailed deer.
4This restoration feature is contingent on sediment testing and approval by WDNR.

Table 6.4 Biological control agents identified by the Oregon Department of Agriculture for purple loosestrife (http://egov.oregon.gov/ODA/PLANT/weed_bioagent_targets.shtml).

Scientific Name of Beetle	Common Name of Beetle
Galerucella calmariensis	defoliating beetle
Galerucella pusilla	defoliating beetle
Hylobius transversovittatus	root weevil
Nanophyes marmoratus	seed head weevil

Biological control agents for release in the United States are vetted by the U.S. Department of Agriculture prior to release. The beetle species listed in Table 6.4 for control of purple loosestrife were previously approved by the U.S. Department of Agriculture and have been released at numerous locations in the United States, including a number of locations in Oregon. A news release by the Oregon Department of Agriculture (http://oda.state.or.us/information/news/2002/021002weeds.html) discusses their successful release in Oregon.

Use of biological control agents (four species of beetles) is intended to control the presence, density and distribution of purple loosestrife. Even with successful establishment of these biological control agents, however, a residual population of purple loosestrife will likely remain. By helping to control purple loosestrife in the Columbia River estuary and thereby re-establishing the diverse native vegetation of tidal marsh habitats, this restoration feature is likely to benefit ESA-listed salmonids. These changes should benefit habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability.

Tenasillahe Island Tidegate and Inlet Modifications. This ecosystem restoration feature will improve both habitat connectivity and water quality of interior channels at Tenasillahe Island that are currently located behind flood control dikes and tidegates. NMFS anticipates that this action will benefit ESA-listed salmonids by opening up access to productive rearing and refuge areas that are not now accessible to juvenile salmonids. This action will result in improvements to water quality, habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia and habitat-specific food availability.

Juvenile salmonids should be able to access additional acres of productive tidal marsh and swamp habitat for rearing and foraging upon modification of the tidegates and potentially the construction of the inlet channels. Construction impacts from tidegate modification and inlet construction are anticipated to be of short duration (a few days to two weeks). However, since in-water work would be required, some limited-duration harassment of ESA-listed salmonids from the turbidity plume may occur. Through appropriate timing, impacts to juvenile salmonids in the immediate construction area can be further minimized. NMFS anticipates that this action will benefit ESA-listed salmonids by opening up access to productive rearing and refuge areas that are not now accessible to juvenile salmonids. This action will result in improvements to water quality, habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia and habitat-specific food availability.

Modification of the main tidegate feature, a three-barrel structure, will likely occur out of the water as the tidegates are located in a concrete lined well in the center of the flood control dike. The secondary tidegate will likely be modified in the dry also by removing the tidegate from its hinges during low tide and immediately installing a modified tidegate. However, if our hydrologic analysis indicates that these structures should be lowered or tidegates added, then soil disturbance of either the existing flood control levee or the adjacent stream substrate would occur as excavation and/or installation of cofferdams would occur.

Construction of inlet channels would require some excavation in the upper tidal zone that can be accomplished during low tide to limit turbidity. However, since in-water work would be required, some limited-duration impact to ESA-listed salmonids from the turbidity plume may occur. Through construction during the inwater work period (July 1 to September 15), impacts to juvenile salmonids in the immediate construction area can be further minimized.

Incidental take for this action was estimated as zero adults and 36 juvenile salmonids. Adult salmon in the Columbia River during the construction period will be migrating upstream following the main channel or main side channels of the Columbia River. Multnomah Slough, into which the two tidegate structures at Tenasillahe Island empty, would receive only incidental, transitory use by adults migrating upstream. The openings of the tidegates, which are setback from the main channel of Multnomah Slough, offer no attraction (*e.g.* cool water outflow) for adult salmon or steelhead. The proposed inlet channels, one abutting the mainstem Columbia River and the other Clifton Channel, a main side channel, lie beside migration routes for adult salmon and steelhead. As noted above, inlet construction would occur during low tide in a narrow corridor of tidal marsh/mudflat habitat that does not represent a migratory corridor for adult salmonids. Consequently, we have determined that the proposed action would result in zero incidental take of adult salmonids.

Juvenile salmonids may occur in low numbers in the vicinity of the tidegate outlets and inlet channels. Haskell *et al.* (2004) monitored and evaluated juvenile salmonid usage of main channel, backwater, marsh, and T-channel locations at Crims Island, Columbia River Mile (RM) 54-57 from May through September 2003. The Crims Island location is considered comparable to the Tenasillahe Island restoration location (RM 36-38) for water conditions (temperature, dissolved oxygen, flow) and use by juvenile salmonids. Haskell *et al.* (2004) reported the capture of three species of juvenile salmonids at Crims Island: Yearling and subyearling Chinook salmon, yearling and subyearling coho salmon, and chum salmon. Subyearling Chinook salmon comprised approximately 4% of the total fish captured at Crims Island; the other salmonids comprised 0.01% or less of the total fish captured (Haskell *et al.* 2004). They reported that seasonal abundance of subyearling Chinook salmon at Crims Island was highest in late April to early May and that by late June, these subyearlings were primarily found only at the mainstem beach sampling location. They attributed the increase in water temperature to the seasonal decrease in presence of juvenile salmonids at the Crims Island location. Haskell *et al.* (2004) reported a catch per unit effort level of approximately 6 or fewer subyearling Chinook salmon per hour after the middle of July for backwater locations at Crims Island.

Comparable results are expected for the Tenasillahe Island tidegate and inlet locations. Water temperatures at the two-tidegate locations on Multnomah Slough, Tenasillahe Island, are expected to be too warm for substantial use by juvenile salmonids before the start of the inwater work period. Consequently, their presence at these tidegate locations would be minimal. The inlet locations at Tenasillahe Island are considered comparable to the main channel sampling location at Crims Island reported by Haskell (2004). Subyearling Chinook density at the mainstem beach location at Crims Island was as high as approximately 0.6 fish per square meter through July 29, but decreased thereafter to 0.2 fish per square meter or less (Haskell 2004).

The incidental take level for simple replacement of the tidegates would be zero juvenile salmonids if only the flapgates are replaced during low tide when water is not present on the site. If sheet pile cofferdams were required at these locations, inwater work at low tide would take an estimated eight hours at the single barrel location and 16 hours at the 3-barrel location. Installation of sheet pile cofferdams would occur during low tide when minimal water is within the confines of the cofferdam with final closure at the lowest tide stage. Water temperature, closure at the low tide stage, and disturbance associated with construction of the cofferdam should effectively preclude most juvenile salmonids from the location. However, potential exists to entrap juvenile salmonids behind the cofferdam as the structure is closed. We estimate that 6 juvenile salmon could be entrapped during cofferdam closure (one hour operation) at each location for an incidental take of 12 juvenile salmonids associated with tidegate construction.

Construction of inlet pipes through the flood control levee would have a similar impact to tidegates. Placement of sheet pile cofferdams on the riverward side of the levee could result in the entrapment of juvenile salmonids. Again, water temperature, closure at the low tide stage and disturbance associated with construction of the cofferdam should effectively preclude most juvenile salmonids from the location. However, potential exists to entrap juvenile salmonids behind the cofferdam as the structure is closed. We estimate that 6 juvenile salmon could be entrapped during cofferdam closure (one hour operation) at each inlet location (2) for an incidental take of 12 juvenile salmonids.

The construction of inlet channels, should it require two low tide events to complete construction, could result in the entrapment of some juvenile salmonids in the inlet channel during the next low tide when construction resumes. The riverward end of the inlet channel is intended to blend into the existing tidal marsh topography thus allowing for juvenile salmonids to readily escape on the falling tide. Construction efforts, with a tracked excavator and bucket, could result in a shallow trench initially that could serve to trap juvenile salmonids on the falling tide. Entrapment of these juvenile salmonids would likely occur during a one-hour period as the tide falls below the surface elevation of the tidal marsh at the inlet channel locations and water remains pooled in the completed portion of the inlet channel, thus entrapping juvenile salmonids. Turbidity in the constructed channel during construction activity on the second low tide event could thus take entrapped juveniles. We are estimating that 6 juvenile salmonids could be incidentally taken during each inlet channel construction effort for an incidental take of 12 juvenile salmonids during this phase of the operation. Upon completion of the inlet channel to the inlet pipe and initiation of operations of the inlet systems, the incoming and outgoing tide would quickly erase any elevation difference between the inlet channel and adjacent tidal marsh thus eliminating the potential for entrapment of juvenile salmonids.

Tenasillahe Island Historical Habitat Restoration. Long-term Tenasillahe Island restoration features will only occur if Columbian white-tailed deer are delisted and the eventual long-term Tenasillahe Island restoration plan is consistent with the Julia Butler Hansen National

Wildlife Refuge's purpose and goals. This restoration action will be developed in the future, and therefore would undergo site-specific Section 7 ESA consultation when fully designed. Conceptually, NMFS believes that should this project be undertaken, numerous ecosystem indicators would be benefitted, including tidal marsh and swamp habitat, and all pathways associated with habitat primary productivity, food web, salmonid growth, and salmonid survival.

Bachelor Slough. The original project was designed to increase river flows traveling through Bachelor Slough, with associated improvements in water quality and habitat connectivity. Juvenile salmonids would be more likely to be drawn into Bachelor Slough under these changed conditions during the outmigration. Cooler temperatures would be beneficial to fish drawn into Bachelor Slough. Additionally, 6 acres of riparian habitat would be restored along the Bachelor Slough shoreline, plus additional riparian forest habitat would be developed on the disposal areas associated with this activity.

The revised project is limited to the development of six acres of riparian forest habitat along Bachelor Slough and potentially some additional riparian forest habitat on Washington Department of Natural Resources land should it be used as a disposal site for borrow material from the restoration action along Bachelor Slough. Dredging of Bachelor Slough is no longer under consideration due to lack of an adjacent, cost efficient disposal location. Riparian forest restoration slated for dredged material disposal sites was dropped from consideration after sediments from Bachelor Slough were determined to be sand, not silt. The Ridgefield National Wildlife Refuge did not want sand placed on refuge lands nor were they going to allow for borrow of topsoil from refuge lands to cap the sandy disposal material. Consequently, the proposed action was scaled back to simply encompass the riparian forest restoration along Bachelor Slough.

Riparian forest restoration would provide for detrital and insect export to the Columbia River. Permanent riparian forest habitat would provide for export of large woody debris to the Columbia River and its estuary over the long term.

Excavation along the Bachelor Slough shoreline to remove exotic vegetation and some soil overburden would occur in early May to prepare a bare mineral soil for onset of seed distribution by native cottonwoods and willows which begins approximately mid-May. Construction activities would be out of the water. The construction area would be sloped from the base of the flood control dike to the ordinary high water mark. Potentially, higher waters from a Columbia River freshet may cover part or all of the restoration area post-construction. Some release of sediment and associated turbidity can be expected from the site under these conditions. Establishment of seedling trees and other vegetation should preclude such discharges in subsequent years. Due to the project timing and the current, low quality salmonid habitat in Bachelor Slough, NMFS does not believe this project will have long-term adverse effects on ESA-listed salmonids.

Incidental take for this restoration feature is estimated a zero adults and 20 juveniles. The construction timeframe during May coincides with the period when migrant adult spring Chinook and steelhead are in the Columbia River. These adults could potentially transit the project area by first accessing Lake River and then returning to the Columbia River via Bachelor Slough. Juvenile salmonid outmigrants representing most Columbia River ESUs could be transiting through Bachelor Slough in May as the timeframe is near the peak period for juvenile outmigrants.

The construction effort in early May would occur above the ordinary high water (OHW) mark. Bank sloping would occur but would grade from the landward edge to OHW at Bachelor Slough. The construction effort would not leave depressions and/or swales that could entrap adult or juvenile salmonids should a freshet occur post-construction that would overtop the construction area. Given that construction would occur above the OHW mark and would be either discontinued or delayed if water levels exceeded OHW, and banks would be gradually sloped, we have determined that no adult salmonids would be incidentally taken by the proposed action. These factors would similarly limit incidental take for juvenile salmonids.

The potential exists that during the first year post-construction for a limited number of juvenile salmonids to become stranded as the tide recedes during a freshet event that exceeds the OHW mark or from wave action in Bachelor Slough during water levels exceeding OHW. Wave action generated by wind is probably minimal as the slough is relatively narrow with levees along both shorelines. Recreational boat traffic is apparently not substantial and would be a limited source of waves. There is no commercial boat traffic on Bachelor Slough. Ship wake, greatly attenuated, from the Columbia River Navigation Channel does enter the upstream reach of Bachelor Slough and would reach the upstream limits of the proposed restoration action. We have estimated this incidental take from stranding to be 20 juvenile salmonids based on the limited chance of a freshet event that exceeding the OHW mark or from wave action in Bachelor Slough during water levels exceeding OHW. Vegetative cover would be established by May of the year following construction and should preclude juvenile salmonids from approaching the shoreline-water interface where stranding as the tide recedes would be expected to occur.

Columbia River Tidegate Retrofits. The Corps originally proposed to retrofit the tidegates on five tributaries to the Columbia River, and to conduct additional tidegate retrofit activities on other tributaries in the future. The Oregon tributaries include Tide Creek, Grizzly Slough, and Hall Creek (Warren Slough), and the two Washington tributaries include Burris Creek and Deep River. Further information on these proposals is in Chapter 8.4 of the 2001 BA, in the 2001 BA addendum, and Chapter 4 of the Corps 1999 FEIS. That information is incorporated here by reference. Construction actions are of short duration (*e.g*., less than one week per structure) and soil disturbance, thus turbidity, would typically be limited in nature. If the entire tide gate and associated culvert require replacement, temporary coffer dams would be placed on each end of the culvert to preclude sediment impacts to the stream. However, since inwater work would be required, some limited duration harassment from the turbidity plume may occur to ESA-listed salmonids. The tidegate at Hall Creek (Warren Slough) was retrofitted by others subsequent to publication of the Final Supplemental EIS (2003) and has been dropped from further consideration.

Juvenile salmonids could be expected on either the downstream side or upstream (tributary) side of each tidegate location proposed for modification. Juvenile salmonids are assumed to be present immediately upstream of the tidegate location have either originated in that specific tributary or were able to enter the tributary through the tidegate. The exception to this assumption would be Burris Creek, where the local diking district previously plugged the tidegate and relied on a pump station to discharge water from within the district. No adult salmonids are thought to ascend Burris Creek at this time as there is no means for their passage through the flood control levee.

The Tide Creek location is on the mainstem Columbia River at approximately RM 82. Burris Creek occurs at RM 81 on a sidechannel of the Columbia River. Grizzly Slough (RM 28) and Deep River (RM 22) tidegate locations are both well off-channel at locations adjacent to the widest portion of the Columbia River estuary. Grizzly Slough is a small back channel separated from a main back channel (Blind Slough) by a flood control levee. Thus it has no spawning habitat. The Deep River tidegate locations, approximately three, contain spawning and/or rearing habitat upstream of the tidegate locations.

Construction actions at each location are projected to be of short duration (*e.g.*, less than one week per structure) and soil disturbance resulting in increase turbidity would typically be limited in nature. Construction would occur between July 1 and September 15, the inwater work period, when the fewest juvenile salmonids are expected to present in the area. If the entire tide gate and associated culvert require replacement, temporary sheet pile cofferdams would be placed around each end of the culvert to preclude sediment impacts to the tributary stream and to the system that the tributary discharges. Installation of the two sheet pile cofferdams at each tidegate location would occur during low tide when minimal water is within the confines of the cofferdam with final closure of the cofferdam at the lowest tide stage. Water temperature, closure at the low tide stage, and disturbance associated with construction of the cofferdams should effectively preclude most juvenile salmonids from the location.

However, potential exists to entrap juvenile salmonids behind each cofferdam at these tributary locations as the structure is closed. The Corps estimates that 6 juvenile salmon could be entrapped behind each cofferdam during closure (one hour operation) at each location. The estimate of 6 juvenile salmon entrapped at these locations is predicated upon Haskell *et al.* (2004). They reported a catch per unit effort level of approximately 6 or fewer subyearling Chinook salmon per hour after the middle of July for backwater locations at Crims Island (*see* discussion under 6.7.2.4 Tenasillahe Island Tidegate and Inlet Modifications for greater detail).

Incidental take is estimated at 12 juvenile salmonids (6 juveniles per cofferdam) for Tide Creek, 12 juvenile salmonids for Grizzly Slough, 36 juvenile salmonids for three locations on Deep River, and 6 juvenile salmonids for Burris Creek. Total incidental take is estimated at 66 juvenile salmonids with take occurring only during construction.

Although adult salmonids will either pass by or through the tidegate locations proposed for modification, no incidental take is anticipated for adult fish. The construction period (July 1 to September 15) is outside the timeframe when adults ascending spawning streams would occur. The nature of the construction action precludes entrapment of adults. They would easily avoid an area where a cofferdam is being constructed due to the associated disturbance. The construction locations are well off main channel, even in the case of Tide Creek, so as not to disturb or take main channel adult migrants.

The tidegate retrofit restoration feature is estimated to provide or improve anadromous fish access to 38 miles of tributary streams. These tributaries contain spawning, stream rearing, and (near their confluence with either the Columbia River or a more major tributary) backwater channel and freshwater marsh habit for rearing and/or overwinter refuge from floods. Additionally, the Corps would replace additional tidegates, if additional tidegate retrofit projects were identified. This action should result in short- and long-term improvements to habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability by reconnecting the Columbia River to these tributary streams.

Walker/Lord and Hump/Fisher Islands Channel Connectivity Enhancements. The purpose of this restoration action is to improve water flow and circulation through this island complex, thereby lowering embayment temperatures and creating a network of channels. This feature should increase habitat connectivity and improve foraging conditions for juvenile salmonids. Construction activities are primarily upland in nature and involve construction of a channel in a historical dredged material deposition area. A brief period of in-water construction would occur when the channels are daylighted to the embayment and river. Opening of the ends of the channels would occur at low tide to limit sediment discharge. The channel at the Walker/Lord Island location was completed in September 2004; all excavation occurred in the dry.

Given the short duration of the construction action and the fact that material to be excavated is primarily medium-grained sand, turbidity in adjacent waters should be of short duration and extent. Construction timing would typically be late summer to take advantage of lower water levels, dry soil conditions, and the general absence of fish. As a result, the potential for short-term adverse impacts to salmonids would be minimized. Due to timing and location of the inwater action, NMFS does not believe this restoration action will take ESA-listed salmonids. This restoration will provide some short- and long-term improvements to habitat complexity, connectivity, or conveyance; feeding habitat opportunity; refugia; and habitat-specific food availability indicators.

Martin Island Embayment Modification. The Martin Island embayment modification will not be constructed due to objections from the State of Washington.

6.7.3 Ecosystem Research Actions

Ecosystem research actions are measures proposed by the Corps to assist the efforts of the Corps, NMFS, FWS, and others in understanding the broader issues of the Lower Columbia River, estuary and river mouth. These research actions address indicators of the salmonid conceptual ecosystem model, and are intended to provide useful information for the conservation and recovery of ESA-listed salmonids. The annual and cumulative results will be presented to the adaptive management team. NMFS strongly supports implementation of these ecosystem research activities.

Effects to ESA-listed salmonids are expected to occur from implementation of ecosystem research activities. Because any impact to ESA-listed salmonids from research activities is directed and intentional, instead of incidental to the purpose of the action, the future implementation of these research activities may require the issuance of research permits authorizing direct take of ESA-listed salmonids by NMFS under Section 4(d) or 10(a)(1)(A) of the ESA.

6.8 Summary of Effects of the Proposed Action on the Biological Requirements of Proposed and ESA-Listed Salmonids

NMFS' analysis in section 6.2.1 of this Opinion indicated that direct effects to ESA-listed salmonids would be limited. NMFS concurs with the Corps' general assessment of potential Project indirect effects during the two-year construction period of navigation improvements. Based on the conceptual ecosystem model, impacts to key physical processes will adversely affect habitat forming processes, *i.e.*, the "building blocks"of salmonid habitat in the Lower Columbia River, estuary and river mouth. These key physical processes include suspended sediment, accretion/erosion, turbidity, salinity, bathymetry, and bedload. Short-term indirect effects to these key physical processes will be of a limited nature during the Project construction period as discussed during the SEI panel process, and validated using the numerical modeling conducted by WES and OHSU/OGI.

Based on these direct and indirect Project effects, NMFS believes that population abundance, growth rate, spatial structure, and diversity of ESA-listed salmonids will not be appreciably reduced. NMFS also believes that the Project will not appreciably reduce, other than during short-duration and limited locations of salmonid avoidance of dredging and disposal operations, the distribution of ESA-listed salmonids. Of all ESA-listed salmonids, only Columbia River chum salmon spawning habitat occurs in the Project area. However, NMFS believes the direct and indirect effects of the Project will not appreciably reduce any of the ESA-listed salmonid ESUs' population numbers, distribution within each ESU, or reproductive success.

The 2001 BA characterized changes to key habitats and indicators over the life span of the Project as not being significant because they are within the natural variation of river conditions or will not change river conditions at all (*e.g*., bedload changes, volume and rate of suspended sediment transport, water level changes to the estuary, structure, distribution, net productivity, and detritus production of marshes and swamps, the location of mobile macroinvertebrates, velocity changes in shallow water habitats and available refugia, salinity changes as they impact habitat types, bathymetry, and the impact on habitat opportunity as it relates to water depth in the estuary).

During the reinitiation of the consultation process in 2001-2002, NMFS identified certain issues regarding long-term effects of the Project. Those issues centered on limited physical effects associated with Project actions that are not detectable in the short term, but that may affect ESA-listed salmonid habitats over the life span of the Project. These include ecosystem effects that are not quantifiable based on the NMFS' review of best available science and our current understanding of the ecosystem. Topics of concern identified during this reinitiation include those related to the ETM, formation and preservation of tidal marsh and swamp habitats, habitat opportunity changes in isolated geographic areas, and elimination of connectivity between habitats relied on by juvenile salmonids.

The changes to physical processes resulting from the Project will likely result in incremental changes in the physical conditions in the Lower Columbia River, estuary and river mouth. Any changes in a static system should be predictable, using modeling and other tools. However, the ecosystem of the Lower Columbia River, estuary and river mouth is not a static system. Numerical modeling cannot account for this non-static state. As acknowledged in the 2001 BA, these changes will result in a new dynamic equilibrium in the Lower Columbia River ecosystem over the life span of the Project.

Notwithstanding the Corps' assessments, NMFS believes that the predicted changes to the physical system should not be extrapolated over the life span of the Project without additional monitoring and verification. In the OHSU/OGI modeling for the reinitiation of consultation, the predicted changes to habitat opportunity in Cathlamet Bay for five one-week model simulations (Table 6-1 of the 2001 BA) are from model simulation runs over a short time duration. Based on the information provided in the 2001 BA, extrapolating these results over the life span of the Project, instead of limiting those results to the period modeled, does not acknowledge model limitations or long-term variability in the ecosystem.

A key conclusion from both the SEI panel process and BRT discussions was that even using the best available scientific data, there remains a degree of risk and uncertainty with our ability to link the physical changes in habitat elements predicted from the Project with long-term effects - either positive, negative or neutral - to ESA-listed salmonids or their habitats. The BRT conducted a qualitative risk and uncertainly analysis (*see* Table 7-1 of the 2001 BA). That analysis documented the need for a precautionary approach to the protection of ecosystem elements (*i.e.*, key indicators within each pathway of importance to salmonids). In order to address the risk and uncertainties associated with key salmonid pathways and indicators identified in this Opinion, the Corps proposes, and NMFS concurs, with the continued development and implementation of a robust monitoring program and adaptive management process.

7. CRITICAL HABITAT

7.1 Defining Proposed and Designated Critical Habitat

7.1.1 Status of Critical Habitat

ESA Section 3(5)(a) defines 'critical habitat' as the specific areas within: (1) The geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features essential to the conservation of the species; (2) which may require special management considerations or protection; and (3) specific areas outside the geographical area occupied by the species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species. In determining what areas are critical habitat, agency regulations at 50 C.F.R. 424.12(b) require that NMFS must "consider those physical or biological features that are essential to the conservation of a given species ..., including space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, and rearing of offspring; and habitats that are protected from disturbance are representative of the historical geographical and ecological distribution of a species."

The regulations further direct us to "focus on the principal biological or physical constituent elements . . . that are essential to the conservation of the species," and specify that the "known primary constituent elements shall be listed with the critical habitat description." The regulations identify primary constituent elements (PCE) as including, but not limited to "roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types." An occupied area must contain one or more of the PCEs at the time the species is listed to be eligible for designation as critical habitat; an area lacking a PCE may not be designated in the hope it will acquire one or more PCEs in the future.

PCEs consist of the physical and biological elements identified as essential to the conservation of the species in listing and recovery documents. These PCEs include sites essential to support one or more life stages of the ESU (sites for spawning, rearing, migration and foraging) and contain physical or biological features essential to the conservation of the ESU, for example, spawning gravels, water quality and quantity, side channels, and forage species.

The specific type of site and associated features most relevant to this Opinion is called **'estuarine areas'** free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. The 2002 Opinion identified that the proposed Project may affect the following five essential features: Substrate, water quality, food, riparian vegetation, and safe passage conditions. These five essential features are encompassed in the newly-proposed PCEs and 'estuarine areas' site type in this Opinion. Therefore, this analysis of the effects of the proposed action on critical habitat focuses on the role that proposed and designated critical habitat must play with respect to the recovery of the species potentially affected by the Project. This analysis does not rely on the regulatory definition of "destruction or adverse modification" at 50 C.F.R. 402.02 of critical habitat recently invalidated by the Ninth Circuit in *Gifford Pinchot.*

NMFS reviews the status of critical habitat by examining the condition and trends of PCEs throughout the designated area, a region that corresponds approximately to the geographic range of the species. Within the action area, critical habitat has been designated for SR fall-run Chinook salmon, SR spring/summer-run Chinook salmon, and SR sockeye salmon. On December 14, 2004, NMFS proposed critical habitat for SR steelhead, UCR steelhead, MCR steelhead, UWR steelhead, LCR steelhead, UCR spring-run Chinook salmon, UWR Chinook salmon, LCR Chinook salmon, and CR chum salmon in the Lower Columbia River and estuary. 69 FR 74572; Dec. 14, 2004. Critical habitat was not proposed for LCR coho salmon (an ESU currently proposed for listing).

The December 14, 2004, proposed critical habitat rule identified the following characteristics of the Lower Columbia River corridor:

- The corridor was acknowledged to be of high conservation value to all the ESUs that migrate through the estuary.
- Estuarine areas are crucial for juvenile salmonids, given their multiple functions as areas for rearing/feeding, freshwater saltwater acclimation, and migration (Simenstad *et al*., 1982; Marriott *et al*. 2002, as cited in 69 FR 74572).

- The corridor connects every watershed and salmonid population with the ocean and is used by rearing/migrating juveniles and migrating adults.
- The Columbia River estuary is a particularly important area for these ESUs as both juveniles and adults make the critical physiological transition between life in freshwater and marine habitats (Marriott *et al*.2002, as cited in 69 FR 74572).

Therefore, all ESUs have proposed or designated critical habitat that includes the lower Columbia River to the Pacific Ocean, ending at the submerged potions of the North and South Jetties.

7.1.2 Analysis of Effects to PCEs of Proposed and Designated Critical Habitat

NMFS' review of the Project's effects on designated and proposed critical habitat (as it relates to the recovery of ESA-listed species) re-examined each of the analytical components of the consultation that resulted in the 2002 Opinion. The effects analysis was based on the conceptual ecosystem model, the underlying physical modeling, and associated ecosystem pathways and indicators that describe estuary functions that will likely be affected by this Project. The essential features of critical habitat, including the new PCEs proposed in NMFS' December 14, 2004, proposed rulemaking, are also encompassed by the conceptual ecosystem model and associated ecosystem pathways and indicators (*see* Chapter 5 of the Corps 2001 BA).

The conceptual ecosystem model, the underlying physical modeling and the associated ecosystem pathways and indicators not only address short-term, direct impacts from the Project, but also long-term indirect effects during the period of operation and maintenance (50 years and beyond) that could affect the recovery of ESA-listed salmonids. Therefore, these tools and the analysis in this Opinion also address the potential effect of the Project on the conservation value of proposed and designated critical habitat.

For the existing disposal sites identified in the amendment letter to the 2001 BA and analyzed in section 6.2.1 of this Opinion (Direct Effects), the disposal operations at existing upland sites are likely to have limited, localized negative effects on the PCEs for proposed and designated critical habitats, with longer-term benefits. Because of their location, the new upland disposal sites identified in the Corps' April, 2002, letter do not provide PCEs for proposed and designated critical habitat.

Indirect effects are analyzed in section 6.2.2 of this Opinion. The effects analysis from NMFS' 2002 Opinion addresses the newly-proposed PCEs. This is because the essential features addressed in the 2002 Opinion (*i.e*, substrate, water quality, food, riparian vegetation, and safe passage conditions) are encompassed by these new PCEs.

The similarity between essential features and PCEs for critical habitat can be illustrated in reviewing the analysis for physical habitat indicators such as bathymetry and salinity. For example, changes in the ecosystem indicators of bathymetry (and its impact to velocity) and salinity can affect PCEs in the action area of the Project. NMFS reviewed the Corps WES model and the OSHU/OGI CORIE model in order to address physical changes to the system, such as bathymetry, stemming from the Project. The CORIE model is particularly relevant to the critical habitat analysis because it translates physical effects into the concept of "habitat opportunity."

For example, the CORIE model translates changes in bathymetry to velocity to assess effects to habitat opportunity. NMFS has determined a range of velocities that are favorable for juvenile salmonids (Bottom *et al.* 2001). Actions that do not reduce habitat opportunity would generally be considered to satisfy the requirement that an action not appreciably diminish the value of critical habitat to recovery. Actions that increase habitat opportunity would likely support recovery.

Modeling results for the Project indicated a small difference between pre- and post-Project velocity differences. Pre-and post-Project velocity differences in shallow salmonid habitat areas outside the navigation channel ranges from approximately -0.05 to 0.05 foot per second. The post-Project velocities are well within the range of favorable velocities identified for juvenile salmonids, as defined by NMFS (Bottom *et al.* 2001). The OSHU/OGI model used pre-and post-Project velocity to measure effects to habitat opportunity. The model runs for the post-Project scenario estimated higher habitat opportunity hours than the environmental baseline (pre-Project condition).

Another ecosystem indicator that can affect critical habitat is salinity. As discussed in Section 6 of this Opinion, the concentration of salinity in important habitat and rearing areas of the estuary and the longitudinal gradient of salinity between the freshwater and ocean environments that bound the estuary are important to salmonid growth and survival. In shallow areas of Cathlamet Bay and Grays Bay, where important juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted a post-Project salinity increase of 0.1 to 0.15 ppt. The OHSU/OGI model confirmed these predictions. Within the deeper navigation channel, where limited juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted post-Project salinity increases in the range of 1.0 to 1.5 ppt. The OHSU/OGI model confirmed these findings, but predicted slightly larger increases in salinity than those predicted by WES RMA-10 modeling for Youngs Bay and along the Oregon side of the navigation channel up to Tongue Point. Using the OHSU/OGI model an example of the potential changes to habitat opportunity was developed by modeling Cathlamet Bay for five one-week model simulations (*see* Table 6-1 of the 2001 BA). While the Project will change the estuary's cross-sectional profile that affects estuary salinity gradients, the model predicted, for important, shallow water Cathlamet Bay salmonid habitats, there was virtually no difference in the pre- and post-Project habitat opportunity for salinity between 0-5 ppt.

In addressing potential impacts critical habitat from the Project, NMFS also recognizes that the adaptive management process identified in the 2002 Opinion will be an essential tool to respond to new information generated from Project monitoring. This mechanism provides the ability to add future conservation measures to the Project if new information suggests that effects to habitat might diminish its value in a way that would affect species recovery.

Since the development of the 2002 Opinion, the Lower Recovery Fish Recovery Board utilized the conceptual ecosystem model and ecosystem pathways and indicators in the development of their December 2004, subbasin plan, *Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan*. The goal of the plan is to have Washington Lower Columbia salmon and steelhead recovered to healthy, harvestable levels that will sustain productive recreational, commercial, and Tribal fisheries. The plan outlines an adaptive management approach over the next 25 years. The subbasin plan is designed to integrate new information on successes of recovery actions, as well as on threats to salmon and steelhead, so that future work can be tailored to support recovery efforts.

The Lower Columbia River Estuary Partnership (LCREP) is also completing a subbasin plan, the *Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan,* for the lower Columbia River and Oregon tributaries. The LCREP subbasin plan also refers to the conceptual ecosystem model and ecosystem pathways and indicators from the 2001 BA and the 2002 Opinion. The LCREP subbasin plan is consistent the LCFRB's document in that it provides strategies and recommendations for actions that result in fish and wildlife resources and their habitats maintained at healthy levels and clean, safe water that is available for people, fish, and wildlife.

In addition, the Corps is working with the Pacific Northwest National Laboratory, the LCREP, and a number of other interested partners to develop the *Columbia River Estuary Conceptual Model project* (https://www.nwp.usace.army.mil/Pm/LCR/docs/CREConceptmodel/START.htm). The Project's purpose is to develop an integrated conceptual ecosystem model of the Lower Columbia River and estuary. This model is intended to provide a technical basis for restoration planning, monitoring, and research needs identification and is built, in part, upon the conceptual ecosystem model developed in the Corps' 2001 BA.

Therefore, the conceptual ecosystem model, including the associated ecosystem pathways and indicators, has proven useful for broader recovery efforts in the Lower Columbia River. NMFS has again used the conceptual ecosystem model to review the direct and indirect effects of the proposed action on the physical and biological features that were the basis for proposing and designating critical habitat in the Lower Columbia River and estuary.

Based on the newly-proposed PCEs and specific type of site and associated features (*i.e*., estuarine areas) and associated analysis presented in sections 6 and 7 of this Opinion, NMFS concludes that the Project will not modify PCEs of critical habitat within the action area in a manner that diminishes the potential of the ESA-listed salmonids to recover. Specifically, NMFS concludes that the Project's effects fall into one of the following general categories: (1) Effects that improve the value of critical habitat; (2) effects that are within the range that do not adversely affect ESA-listed salmonids; (3) effects that are minimal/limited, but do not affect habitat that is likely to be important to the recovery of the species, (4) effects that are uncertain over the long term, but that are being addressed through the adaptive management process. Neither the 2002 Opinion nor this reinitiation identified any adverse effects to proposed or designated critical habitat that would appreciably diminish habitat value to the recovery of the ESA-listed species.

7.1.3 Analysis of Essential Features of Proposed and designated Critical Habitat - Ecosystem Restoration Features

With the exception of the Cottonwood-Howard island translocation of Columbian white-tailed deer and Shillapoo Lake (no salmon access), the proposed ecosystem restoration features will have the potential to benefit proposed and designated critical habitat (*see* April 15, 2002, amendment letter [Table 6-3]). For the proposed wildlife mitigation features identified in Table

6-3 of the 2001 BA amendment letter, these sites are likely to have limited, localized negative effects on the elements of proposed and designated critical habitats during construction. Once constructed, these sites are likely to provide long-term benefits to the elements of proposed and designated critical habitat.

Direct effects to critical habitat will also occur from implementation of wildlife mitigation measures and implementation of ecosystem restoration features. Ecosystem restoration features that are proposed at the Bachelor Slough site are likely to result in initial, temporary adverse direct effects to critical habitat features, but over the long-term, are likely to produce beneficial effects that would improve current baseline conditions.

Ecosystem restoration features at Tenasillahe Island (interim and long-term) and for the associated tidegate improvements will likely have limited adverse direct effects to proposed and designated critical habitat associated with construction, but over the long term, the direct effects to critical habitat of these actions will improve access to a larger habitat base and improved export of vegetative detritus, insect fauna and large woody debris. The introduction of white-tailed deer at Cottonwood-Howard Island has no direct effect on ESA-listed salmonids or their proposed and designated critical habitat.

The ecosystem restoration feature to reduce purple loosestrife will use the release of up to four species of beetles as biological control agents to reduce purple loosetrife distribution. This action will help control this invasive plant species in the Columbia River estuary and thereby re-establish the diverse native vegetation of tidal marsh habitats. Accordingly, this restoration feature is likely to benefit critical habitat for ESA-listed salmonids. These removal of purple loosestrife should benefit habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability within the Columbia River estuary.

The ecosystem restoration feature to improve water flow and water quality circulation at Lord-Walker and Fisher-Hump Islands via creating a network of channels would result in temporary adverse, direct effects to proposed and designated critical habitat, but over the long term would improve habitat conditions for ESA-listed salmonids.

7.1.4 Summary of Effects of the Proposed Action on Critical Habitat

In addressing potential impacts critical habitat from the Project, NMFS reviewed how the ecosystem pathways and indicators that describe estuary functions as described in conceptual ecosystem model will be affected by this Project. The conceptual ecosystem model and associated ecosystem pathways and indicators not only addresses short-term, direct impacts from the Project, but also long-term indirect effects during the period of operation and maintenance (50 years and beyond) that could affect the recovery of ESA-listed salmonids. Therefore, these tools and the analysis in this Opinion also address the potential effect of the Project on the conservation value of proposed and designated critical habitat.

For the existing disposal sites identified in the amendment letter to the 2001 BA and analyzed in section 6.2.1 of this Opinion (Direct Effects), the disposal operations at existing upland sites are likely to have limited, localized negative effects on the PCEs for proposed and designated critical habitats, with longer-term benefits. Because of their location, the new upland disposal sites identified in the Corps' April, 2002, letter do not provide PCEs for proposed and designated critical habitat.

Indirect effects are analyzed in section 6.2.2 of this Opinion. The effects analysis from NMFS' 2002 Opinion addresses the newly-proposed PCEs. This is because the essential features addressed in the 2002 Opinion (*i.e*, substrate, water quality, food, riparian vegetation, and safe passage conditions) are encompassed by these new PCEs. The analysis for physical indicators such as bathymetry and salinity illustrated that the potential effects from the Project are limited in nature and not anticipated to affect critical habitat to any appreciable degree.

In addressing potential impacts critical habitat from the Project, NMFS also recognizes that the adaptive management process identified in the 2002 Opinion will be an essential tool to respond to new information generated from Project monitoring. This mechanism provides the ability to add future conservation measures to the Project if new information suggests that effects to habitat might diminish its value in a way that would affect species recovery.

8. CUMULATIVE EFFECTS

8.1 Introduction

Cumulative effects are defined in 50 C.F.R. part 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." The action area of the proposed action under consideration encompasses the Lower Columbia River (from Bonneville Dam downstream to the upper end of the estuary at RM 40), estuary (RM 40 to RM 3), and river mouth (RM 3 to the deep water disposal site).

The Project area is currently a disturbed estuarine ecosystem altered by previous dredging to establish the navigation channel, disposal of dredged material, diking and filling, sewage and industrial discharges, water withdrawal, and flow regulation, to highlight a few of the anthropogenic activities that have occurred over the last 100 years. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or will be) reviewed through separate Section 7 consultation processes and are not considered cumulative effects.

State, Tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives. Government and private actions may include changes in land and water use patterns, including ownership and intensity, any of which could affect ESA-listed salmonids or their habitats. Even actions that are already authorized are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and many private land holdings, make any analysis of cumulative effects difficult. This section identifies representative actions and ongoing state and Tribal fish and habitat restoration plans that, based on currently available information, are reasonably certain to occur. It also identifies, to the extent currently possible, existing goals, objectives, and proposed plans by state and Tribal governments. However, NMFS is unable to determine at this point in time whether such proposed plans will in fact result in specific actions which will subsequently lead to cumulative effects.

8.2 State Actions

Each state in the Columbia River Basin administers the allocation of water resources within its borders. Water resource development has slowed in recent years. Most arable lands have already been developed, the increasingly diversified regional economy has decreased demand, and there are increased environmental protections. If, however, substantial new water developments occur, cumulative adverse effects to ESA-listed salmonids are likely. NMFS cooperates with the state water resource management agencies in assessing water resource needs in the Columbia River Basin. Through restrictions in new water developments, vigorous water markets may develop to allow existing developed supplies to be applied to the highest and best use. Interested parties have applied substantial pressure, including ongoing litigation, on the state water resource management agencies to reduce or eliminate restrictions on water development. It is, therefore, impossible to predict the outcomes of these efforts with any reasonable certainty.

In the past, each Columbia River Basin state's economy depended on natural resources, with intense resource extraction. Changes in the states' economies have occurred in the last decade and are likely to continue, with less large-scale resource extraction, more targeted extraction, and significant growth in other economic sectors. Growth in new businesses, primarily in the technology sector, is creating urbanization pressures and increased demands for buildable land, electricity, water supplies, waste-disposal sites, and other infrastructure.

Economic diversification has contributed to population growth and movement in all four states, a trend likely to continue for the next few decades. Such population trends will result in greater overall and localized demands for electricity, water, and buildable land in and near the action area; will affect water quality directly and indirectly; and will increase the need for transportation, communication, and other infrastructure. The impacts associated with these economic and population demands will probably affect habitat features such as water quality and quantity, which are important to the survival and recovery of the ESA-listed salmonids. The overall effect will be negative, unless carefully planned for and mitigated.

Some of the state programs described above are designed to address impacts to habitat features. Oregon also has a statewide, land-use planning program that sets goals for growth management and natural resource protection. Washington State enacted a Growth Management Act to help communities plan for growth and address the effects of growth on the natural environment. If the programs continue, they may help lessen the potential for the adverse effects discussed above.

In July 2000, the governors of Idaho, Montana, Oregon, and Washington released their "Recommendation for the Protection and Restoration of Fish in the Columbia River Basin," with the stated goal of "protection and restoration of salmonids and other aquatic species to sustainable and harvest able levels meeting the requirements of the ESA, the Clean Water Act, the Northwest Power Act and Tribal rights under treaties and executive orders while taking into account the need to preserve a sound economy in the Pacific Northwest." The recommendations include the following general actions related to the Lower Columbia River:

Habitat Reforms

- Designate priority watersheds for salmon and steelhead.
- Provide local watershed planning assistance and develop the priority plans by October 1, 2002, and for all Columbia River basin watersheds by 2005.
- Integrate Federal, state, and regional planning processes with the Northwest Power Planning Council's amended Fish and Wildlife Program.
- Cooperate with Federal, Tribal, and local governments to implement the National Estuary Program for the Lower Columbia River estuary, including creation of salmon sanctuaries.

Funding and Accountability

- Seek funding assistance for existing activities designed to improve ecosystem health and fish and wildlife health and protection.
- Work regionally to create a standardized and accessible information system to document regional recovery progress.

If these recommendations are implemented by the states individually and collectively, they should have beneficial effects on ESA-listed salmonids and their habitats.

8.2.1 Oregon

Most future actions by the state of Oregon are described in the Oregon Plan for Salmon and Watershed measures, which include the following programs designed to benefit salmon and watershed health in the Lower Columbia River:

- Oregon Department of Agriculture water quality management plans.
- Oregon Department of Environmental Quality development of Total Maximum Daily Loads (TMDLs) in targeted basins; implementation of water quality standards.
- Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, and land and water acquisitions.
- Oregon Department of Fish and Wildlife (ODFW) and Oregon Water Resources Department (OWRD) programs to enhance flow restoration.
- OWRD programs to diminish over-appropriation of water sources.
- ODFW and Oregon Department of Transportation programs to improve fish passage; culvert improvements/replacements.
- Oregon Division of State Lands and Oregon Parks Department programs to improve habitat health on state-owned lands.
- State agencies funding local and private habitat initiatives; technical assistance for establishing riparian corridors; and TMDLs.

If the foregoing programs are implemented, they may improve habitat features considered important for ESA-listed salmonids. The Oregon Plan also identifies private and public cooperative programs for improving the environment for ESA-listed salmonids. The success and effects of such programs will depend on the continued interest and cooperation of the parties.

8.2.2 Washington

The state of Washington has various strategies and programs designed to improve the habitat of ESA-listed salmonids and assist in recovery planning. Washington's 1998 Salmon Recovery Planning Act provided the framework for developing watershed restoration projects and established a funding mechanism for local habitat restoration projects. It also created the Governor's Salmon Recovery Office to coordinate and assist in the development of salmon recovery plans. Washington's "Statewide Strategy to Recover Salmon," for example, is designed to improve watersheds.

The Watershed Planning Act, also passed in 1998, encourages voluntary planning by local governments, citizens, and Tribes for water supply and use, water quality, and habitat at the Water Resource Inventory Area or multi-Water Resource Inventory Area level. Grants are made available to conduct assessments of water resources and to develop goals and objectives for future water resources management. The Salmon Recovery Funding Act established a board to localize salmon funding. The board will deliver funds for salmon recovery projects and activities based on a science-driven, competitive process. These efforts, if developed into actual programs, should help improve habitat for ESA-listed salmonids.

Washington's Department of Fish and Wildlife and Tribal co-managers have been implementing the Wild Stock Recovery Initiative since 1992. The co-managers are completing comprehensive species management plans that examine limiting factors and identify needed habitat activities. The plans also concentrate on actions in the harvest and hatchery areas, including comprehensive hatchery planning. The Department and some western Washington treaty Tribes have also adopted a wild salmonid policy to provide general policy guidance to managers on fish harvest, hatchery operations, and habitat protection and restoration measures to better protect wild salmon runs.

Washington State's Forest and Fish Plan were promulgated as administrative rules. The rules are designed to establish criteria for non-federal and private forest activities that will improve environmental conditions for ESA-listed salmonids. The Washington legislature may amend the Shoreline Management Act, giving options to local governments for complying with endangered species requirements in marine areas.

The state of Washington also established the Lower Columbia Fish Recovery Board to begin drafting recovery plans for the lower Columbia region. The future impacts of the board's efforts will depend on legislative and fiscal support. The Washington Department of Transportation is considering changing its construction and maintenance programs to diminish effects on stream areas and to improve fish passage. The program may qualify for a limit under NMFS' 4(d) rule to conserve ESA-listed salmonids.

Water quality improvements will be proposed through development of TMDLs. The state of Washington is under a court order to develop TMDL management plans on each of its 303(d) water-quality-listed streams. It has developed a schedule that is updated yearly; the schedule outlines the priority and timing of TMDL plan development.

Washington State closed the mainstem Columbia River to new water rights appropriations in 1995. All applications for new water withdrawals are being denied based on the need to address ESA issues. The state established and funds a program to lease or buy water rights for instream flow purposes. This program was started in 2000 and is in the preliminary stages of public information and identification of potential acquisitions. These water programs, if carried out over the long term, should improve water quantity and quality in the state.

The Lower Recovery Fish Recovery Board (2004) recently issued a subbasin plan, *Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan*. The goal of the plan is to have Washington Lower Columbia salmon and steelhead recovered to healthy, harvestable levels that will sustain productive recreational, commercial, and Tribal fisheries. The plan outlines an adaptive management approach over the next 25 years. The subbasin plan is designed to integrate new information on successes of recovery actions, as well as on threats to salmon and steelhead, so that future work can be tailored to support salmon recovery efforts.

As with Oregon's state initiatives, Washington's programs are likely to benefit ESA-listed salmonids if they are implemented and sustained.

8.3 Local Actions

Local governments will be faced with similar and more direct pressures from population growth and movement. There will be demands for development in rural areas, as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to growth and population pressure is difficult to assess without certainty in policy and funding. However, future development in Oregon will be governed for the foreseeable future by Oregon's statewide land use planning program, and Washington's will be governed by its Growth Management Act, both of which address issues of natural resource protections.

Increased industrialization associated with regional economic trends and growth patterns may also have the potential to result in additional dredging around dock facilities, alteration and loss of riparian areas, increased pollution, alteration and loss of shallow water habitat, and potential additional dredging for deeper access channels to enable ports to compete with other west coast port facilities. Because there is little consistency among local governments regarding current ways of dealing with land use and environmental issues, both positive and negative effects on ESA-listed salmonids and their habitats from other development caused by regional and national growth trends will probably be scattered throughout the action area.

In Oregon and Washington, most local governments are considering ordinances to address effects on aquatic and fish habitat from different land uses. The programs are part of state planning structures. Some local government programs, if submitted, may qualify for a limit under NMFS' 4(d) rule and/or a Section 10 HCP process which is designed to conserve ESA-listed salmonids. Local governments may also participate in regional watershed health programs, although political will and funding will determine participation and, therefore the effect of such actions on ESA-listed salmonids.

LCREP is also completing a subbasin plan, the *Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan,* for the lower Columbia River and Oregon tributaries. The LCREP subbasin plan is consistent the LCFRB's document in that it provides strategies and recommendations for actions that result in fish and wildlife resources and their habitats maintained at healthy levels and clean, safe water that is available for people, fish, and wildlife.

In addition, the Corps is working with the Pacific Northwest National Laboratory, the LCREP, and a number of other interested partners to develop the *Columbia River Estuary Conceptual Model project* (https://www.nwp.usace.army.mil/Pm/LCR/docs/CREConceptmodel/START.htm). The project's purpose is to develop an integrated conceptual ecosystem model of the lower Columbia River and estuary. This model is intended to provide a technical basis for restoration planning, monitoring, and research needs identification.

8.4 Tribal Actions

Tribal governments will participate in cooperative efforts involving watershed and basin planning designed to improve aquatic and fish habitat. The earlier discussion of the effects of economic diversification and growth applies also to Tribal government actions. Tribal governments have to apply and sustain comprehensive and beneficial natural resource programs such as the ones described below, to areas under their jurisdiction to have measurable positive effects on ESA-listed salmonids and their habitats.

One Tribal program illustrates future Tribal actions that should have such positive effects. The *Wy-Kan-Ush-Mi Wa-Kish-Wit*, or "Spirit of the Salmon" plan is a joint restoration plan for anadromous fish in the Columbia River basin prepared by the Nez Perce, Umatilla, Warm Springs and Yakama Tribes. It provides a framework for restoring anadromous fish stocks, specifically salmon, Pacific lamprey (eels), and white sturgeon in upriver areas above Bonneville Dam. The plan's objectives related to the estuary are as follows:

- Protect the remaining wetlands and intertidal areas in the estuary upon which anadromous fish are particularly dependent.
- Undertake an immediate assessment of remaining and potential estuary habitat.
- Protect existing estuary habitat complexity.
- Evaluate and condition additional proposals for hydroelectric and water withdrawal developments, navigation projects, and shoreline developments on the basis of their impact on estuarine ecology.
- Identify and implement opportunities to reclaim former wetland areas by breaching existing dikes and levees.
- Reestablish sustained peaking flows that drive critical river and estuarine processes.

The plan emphasizes strategies and principles that rely on natural production and healthy river systems. The plan's technical recommendations cover hydroelectric operations on the mainstem Columbia and Snake rivers; habitat protection and rehabilitation in the basin above Bonneville Dam, in the Columbia estuary, and in the Pacific ocean; fish production and hatchery reforms; and in river and ocean harvests. Overall, future implementation of the Spirit of the Salmon plan should have positive cumulative effects on ESA-listed salmonids and their habitats.

The Nez Perce, Warm Spring, Umatilla, and Yakama Tribal governments are now seeking to implement this plan and salmon restoration in conjunction with the states, other Tribes, and the Federal government, as well as in cooperation with their neighbors throughout the basin's local watersheds and with other citizens of the Northwest.

8.5 Private Actions

The effects of private actions are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or they may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects are even more so.

There are a number of private environmental groups working in the Lower Columbia River on conserving and restoring ecosystem functions that benefit salmonids. Those groups include the North American Joint Waterfowl Plan, Ducks Unlimited, Sea Resources, the Columbia Land Trust, and the Columbia River Estuary Study Task force. As independent organizations, each environmental group has its own charter and therefore function independently. However, these groups are coordinating their work through LCREP's science workgroup. Overall, their actions should have positive cumulative effects on ESA-listed salmonids and their habitats.

8.6 Cumulative Effects Summary

Non-Federal actions are likely to continue to affect ESA-listed salmonids. The cumulative effects of non-Federal actions in the action area that are reasonably certain to occur are difficult to analyze, considering the broad geographic landscape covered by this Opinion, the geographic and political variation in the action area, the uncertainties associated with state, Tribal, and local government and private actions, and ongoing changes to the region's economy. Many negative effects, such as impacts to fish habitat from continued urbanization, water extraction, and water quality alterations, are reasonably certain to occur. However, state, Tribal, and local governments have developed plans and initiatives to benefit ESA-listed salmonids. LCREP's CCMP is another important tool currently being used to coordinate organizations as they conduct habitat conservation, restoration, and recovery actions that benefit anadromous fish. Although state, Tribal and local governments have developed plans and initiatives to benefit listed salmon and steelhead, they must be applied and sustained in a comprehensive manner before NMFS can consider them "reasonably foreseeable" in its analysis of cumulative effects. However, the data and information generated from the above identified ESA-listed salmonid plan actions can be incorporated into the Project's adaptive management process to help guide future management of the Project.

9. CONCLUSION

9.1 Introduction

The analysis in the preceding sections of this Opinion forms the basis for conclusions as to whether the proposed action, the Columbia River Federal Navigation Channel Improvements Project, satisfies the standards of Section 7(a)(2) of the ESA. To do so, the Corps must ensure that their proposed action is not likely to jeopardize the continued existence of any listed species or destroy or adversely modify proposed and designated critical habitat. Section 3 of this Opinion describes the constituent components of the proposed action. Section 4 outlines the biological requirements and current status of the ESA-listed salmonids considered in this Opinion. Section 5 evaluates the relevance of the Lower Columbia River and estuary environmental baseline to the ESA-listed species' current status. Section 6 details the likely effects of the proposed action, both on individuals of the ESA-listed species in the action area, as well as to the properly functioning condition of their habitat. Section 7 analyzes the effects of the proposed action on PCEs of proposed and designated critical habitat. Section 8 considers the cumulative effects of relevant non-Federal actions reasonably certain to occur in the action area. On the basis of this information and analysis, NMFS draws its conclusions about the effects of the Project on the survival and recovery of the ESA-listed salmonid species.

In this concluding section, NMFS analyzes whether the proposed action is likely to jeopardize the continued existence of ESA-listed species or result in the destruction or adverse modification of proposed and designated critical habitats. NMFS recognizes the importance of the Lower Columbia River and estuary to the conservation of ESA-listed salmonids, in particular, ocean-type Chinook and chum salmon. The 2004 FCRPS Hydropower Biological Opinion and the Northwest Fisheries Science Center draft report, Salmon at the River's End (Bottom *et al*., 2001), acknowledge that conservation and restoration of habitat in this portion of the Columbia River Basin is essential to the eventual recovery of ESA-listed salmonids.

9.2 Summary of Navigation Channel Improvement Effects - Jeopardy Standard

Based on the effects analyses in section 6 of this Opinion, NMFS believes that the most predictable impacts from the proposed action to ESA-listed salmonids and their habitats in the Lower Columbia River, estuary and river mouth are short-term, physical changes during the construction and subsequent maintenance periods of the Project. Impacts to key physical processes have the potential to affect habitat forming processes. However, expected impacts to these key physical processes will be limited and short-term in nature during the Project construction and maintenance periods. This conclusion was verified during the SEI panel process, as well as during BRT discussions of the numerical modeling conducted by WES and OHSU/OGI. Therefore, Project construction and maintenance impacts to key habitat types (*i.e.*, tidal marsh and swamp, shallow water and flats, and water column) should be limited as well.

Section 6.2.1 (Direct Effects) of this Opinion indicated that Project construction and maintenance would have limited potential to result in the incidental take of ESA-listed salmonids via dredging entrainment and blasting activities. Section 6.2.2 (Indirect Effects) indicated that short-term, physical changes to the habitat-forming process indicators during Project construction and maintenance periods are unlikely to have more than a limited adverse effect on any of the habitat indicators identified in section 6.3 of this Opinion. Section 6.4 of this Opinion analyzes indicators that occur in more than one key habitat. Based on minor predicted changes to key physical habitat-forming processes discussed above, short-term Project effects to habitat complexity, connectivity, and conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability are expected to be limited.

Contaminants (section 6.4.2 of this Opinion) are another indicator that can affect more than one habitat type. NMFS' concerns over resuspension of contaminants by the Project were raised in our August 25, 2000, withdrawal letter for the 1999 Opinion. The environmental baseline clearly indicates that juvenile salmonids are being exposed to toxicants in their food supply (*see* section 5 of this Opinion) in the estuary. However, while the source of those toxicants is not clear, the potential of the Project to exacerbate this situation is unlikely given the characteristics of the material being dredged and disposed of during the construction period. To be as protective as possible, Monitoring Action 5, identified in Table 7-3 of the 2001 BA (page 7-9), addresses the potential for release of contaminants during the construction process and will help identify and minimize the potential to resuspend contaminants during Project construction and maintenance activities.

Based on the limited direct and indirect Project effects on the key indicators of the estuarine habitat conceptual ecosystem model, NMFS concludes that the proposed action would not prevent or delay the achievement of properly functioning habitat conditions for listed species within the action area. In addition, population numbers of ESA-listed salmonids will not be appreciably reduced. NMFS also believes that the Project, other than during short-duration and limited locations of salmonid avoidance of dredging and disposal operations, will not appreciably reduce the distribution of ESA-listed salmonids. Of all ESA-listed salmonids, only Columbia River chum salmon spawning habitat occurs in the Project area. However, NMFS believes the direct and indirect effects of the Project will not appreciably reduce any of the ESA-listed salmonid ESUs' population numbers, distribution within each ESU, or reproductive success. Therefore, NMFS believes that the Project will not appreciably reduce the likelihood of both the survival and recovery of ESA-listed salmonids.

9.2.1 Summary of Navigation Channel Improvement Effects - Critical Habitat

Based on the effects analyses in section 6 of this Opinion, NMFS believes that the most predictable impacts from the proposed action to critical habitat in the Lower Columbia River, estuary and river mouth are short-term, physical changes during the construction and subsequent maintenance periods of the Project. Impacts to key physical processes have the potential to affect habitat forming processes. However, expected impacts to these key physical processes will be limited and short-term in nature during the Project construction and maintenance periods. This conclusion was verified during the SEI panel process and NMFS' review of the numerical modeling conducted by WES and OHSU/OGI. Therefore, Project construction and maintenance impacts to key habitat types (*i.e.*, tidal marsh and swamp, shallow water and flats, and water column) should be limited as well.

Section 6.2.1 of this Opinion indicated Project construction and maintenance would have limited potential to result in the incidental take of ESA-listed salmonids via dredging entrainment. Our indirect effects analysis also determined that short-term, physical changes to any of the habitat-forming process indicators (section 6.2) during Project construction and maintenance periods are unlikely to have more than a limited adverse effect on any of the habitat indicators identified in section 6.3 of this Opinion. Section 6.4 of this Opinion analyzes indicators that occur in more than one key habitat. Based on minor predicted changes to key physical habitat-forming processes discussed above, short-term Project effects to habitat complexity, connectivity, and conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability are expected to be limited.

Contaminants (section 6.4.2 of this Opinion) are another indicator that can affect more than one habitat type. NMFS' concerns over resuspension of contaminants by the Project were raised in our August 25, 2000, withdrawal letter for the 1999 biological opinion. The environmental baseline clearly indicates that juvenile salmonids are being exposed to toxicants in their food supply (*see* Section 5 of this Opinion) in the estuary. However, while the source of those toxicants is not clear, the potential of the Project to exacerbate this situation is unlikely given the characteristics of the material being dredged and disposed of during the construction period. To be as protective as possible, Monitoring Action 5, identified in Table 7-3 of the 2001 BA (page 7-9), addresses the potential for release of contaminants during the construction process and will help identify and minimize the potential to resuspend contaminants during Project construction and maintenance activities.

Based on the limited direct and indirect Project effects on the key indicators of the estuarine habitat conceptual ecosystem model, NMFS concludes that the physical and biological features (riparian vegetation, water quality, substrate, food, and safe passage) of Lower Columbia River and estuary critical habitat will not appreciably diminish the value of critical habitat for the recovery of ESA-listed species.

9.3 Monitoring and Adaptive Management

Because of the low levels of risk and uncertainty surrounding the long-term biological response of ESA-listed salmonids to predicted physical changes, the best available scientific information does not allow NMFS to predict with certainty how the limited physical changes would affect ESA-listed salmonids and their habitats over the life span of the Project. Section 6.8 of this Opinion discusses long-term uncertainty and risk, and reviews the need for reducing long-term uncertainty and risk via a precautionary approach to the protection of ecosystem elements (*i.e.*, key indicators within each pathway of importance to salmonids). Therefore, the Corps proposes, and NMFS concurs, that a robust monitoring program and adaptive management process will address the risk and uncertainties associated with key salmonid pathways and indicators identified in this Opinion. Implementation of the monitoring and adaptive management programs will ensure that long-term Project effects are addressed, and that these long-term effects will not appreciably reduce the likelihood of ESA-listed salmonid survival or recovery through the diminishment of properly functioning habitat conditions.

Monitoring and adaptive management will allow NMFS to verify our conclusion that the Project's long-term adverse effects to ESA-listed salmonids and their habitats are likely to be limited. Based on the results of the monitoring plan and adaptive management process, adjustments may be made to the construction and maintenance activities of the Project. As an additional result of annual monitoring program review, the adaptive management team may decide that mitigation or restoration actions will be necessary to address adverse impacts.

The monitoring program elements and the framework for the adaptive management process, as currently proposed in the 2001 BA, address the main concerns identified in Section 6 (Effects of the Proposed Action), and will ensure that Project-related environmental impacts to the Lower Columbia River, estuary and river mouth are minimized. NMFS also believes that the monitoring program and the adaptive management process provide the Corps with the opportunity to integrate elements of the Project into a broader set of research objectives and restoration features in the Columbia River Basin (*i.e.*, estuary action items in the All-H paper, the 2004 FCRPS Hydropower Biological Opinion, and NMFS' current recovery planning actions).

NMFS and FWS have jointly published a policy statement on adaptive management in the context of and for its habitat conservation plan and safe harbor strategies. While the HCP context may vary in some respects from the implementation of the proposed action, the policy statement provides instructive guidance on the key elements of a scientifically credible adaptive management strategy. As NMFS, FWS and the Corps work to refine the adaptive management process governing the implementation of this proposed action, NMFS and FWS will look to the fundamental elements of its guidance for adaptive management, which may be found in 65 FR 106 at 35242, 35252 (July 1, 2000).

9.4 Ecosystem Research Actions

The Corps has proposed a series of ecosystem research actions (Table 8-1 of the 2001 BA) under Section 7(a)(1) of the ESA. The proposed ecosystem research actions support currently on-going research actions in the Lower Columbia River. They also begin to address longer-term environmental issues of the river's ecosystem, such as contaminants, and will provide a venue via the proposed workshop to better understand and propose meaningful management actions to conserve the ETM. The data and information resulting from the ecosystem research actions can also be brought forward into the adaptive management process to inform and guide future management decisions associated with the Project.

9.5 Ecosystem Restoration Features

The Corps has proposed multiple ecosystem restoration features (*see* Table 8-2 of the 2001 BA) in furtherance of Section 7(a)(1) of the ESA. During BRT discussions, and discussions among the Corps, the Ports, FWS, and NMFS management, participants identified the need to address any proposed restoration features in the context of habitat type, function, and value, and to link those values to ESA-listed salmonids, particularly juvenile salmonids. The ecosystem restoration features also respond to the indications in Sherwood *et al*. (1990) and Bottom *et al*. (2001) regarding estuarine habitat losses and habitats important for restoring the estuary to properly functioning conditions.

An important distinction between the 1999 Opinion and this Opinion is that the Project now includes these restoration features as part of the proposed action. By including the restoration features as part of the Project, the Corps has significantly increased the certainty that these activities will occur and has provided NMFS with the opportunity to evaluate their potential effects on ESA-listed salmonids and proposed and designated critical habitat for those species.

The ecosystem restoration features will provide benefits to the habitat types identified in the conceptual ecosystem model (*see* Chapter 5 of the 2001 BA). When implemented in coordination with NMFS and other entities conducting habitat conservation/restoration features, these features should complement those activities currently occurring in the Lower Columbia River and estuary. For these reasons, NMFS believes that the proposed ecosystem restoration features will benefit ESA-listed salmonids and their habitats. As with the monitoring plan, the adaptive management process, and the ecosystem research actions, the ecosystem restoration features also provide the Corps the opportunity to integrate elements of the Project into a broader suite of research objectives and restoration features in the Columbia River Basin (*i.e.*, estuary action items in the Basinwide Salmon Recovery Strategy or 'All-H' paper, the 2004 FCRPS Hydropower Biological Opinion, and NMFS' current recovery planning actions).

9.6 Jeopardy Conclusion

After reviewing the current status and factors for decline of of ESA-listed salmonids included in this consultation, the environmental baseline in the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Snake River sockeye salmon, Snake River fall Chinook salmon, Snake River spring/summer Chinook salmon, Snake River Basin steelhead, Upper Columbia River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead, Middle Columbia River steelhead, Columbia River chum salmon, Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River spring run Chinook salmon, and Lower Columbia River coho salmon (proposed for listing).

9.7 Critical Habitat Conclusion

After reviewing the current condition and tends of PCEs within the action area, the environmental baseline, effects of the proposed action, and cumulative effects, NMFS concludes that the proposed action will not result in the destruction or adverse modification of proposed and designated critical habitat for Snake River sockeye salmon, Snake River fall Chinook salmon, Snake River spring/summer Chinook salmon, Snake River Basin steelhead, Upper Columbia River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead, Middle Columbia River steelhead, Columbia River chum salmon, Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon, Upper Columbia River spring run Chinook salmon, and Lower Columbia River coho salmon (proposed for listing).

10. CONSERVATION RECOMMENDATIONS

10.1 Introduction

Section 7 (a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on ESA-listed salmonids, to minimize or avoid adverse modification of proposed and designated critical habitat, to help implement recovery plans, or to develop additional information.

10.2 Conservation Recommendations

NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the Corps.

10.2.1 Pile Dike Study

Coordinate with NMFS, FWS, and OSHU/OGI to develop and implement a study that addresses the functioning of and continued need for pile dike fields in the Lower Columbia River, estuary and river mouth in relationship to on-going and future habitat conservation/restoration features. The study results should be used to assess how pile dike fields might be modified and/or removed from the Lower Columbia River, estuary and river mouth to enhance habitat conservation/restoration features in a manner that does not compromise the integrity of the navigation channel. The results of this study should be incorporated into future consultations for maintenance of the navigation channel and any future reinitiation of consultation activities stemming from the September 15, 1995, ESA Section 7 consultation on operation and maintenance dredging from John Day Dam to the Mouth of the Columbia.

10.2.2 Ecosystem Conservation/Restoration

There are a number of ongoing habitat conservation/restoration features in the Lower Columbia River and estuary that are being conducted by the LCREP, the Salmon Recovery Funding Board, the Lower Columbia Fish Recovery Board, Oregon Watershed Enhancement Board, and a number of non-profit organizations. Based on the need to support this continuing work and NMFS and FWS future fish and wildlife recovery efforts, the Corps should continue to implement habitat conservation/restoration features, as identified through this consultation, the November, 2004, updated proposed action for the 2004 FCRPS Hrdropower Biological Opinion and the 2004 FCRPS Opinion itself, Sections 1135, 206, and 536 of the Water Resources Development Act (WRDA), and the Corps General Investigation Report - Section 905(b)(WRDA 86) Analysis, Lower Columbia River Ecosystem Restoration, Oregon and Washington (May, 2001).

The Corps should explore how to employ regulatory flexibility as they implement their authorities when working with potential partners on conservation/restoration features.

The Corps should continue to work on the implementation of LCREP's CCMP via providing policy and technical assistance. The Corps should also work with the LCREP partners to use their annual planning and Congressional appropriation process to establish and provide the appropriate level of funding to implement the CCMP (in particular, Actions 1 - 12, and 28).

10.2.3 Sediment Budget for the Lower Columbia River and Estuary

The Corps should conduct a sediment budget study that includes an analysis of historic sediment volumes in the Lower Columbia River, how sediment volumes have changed with development of the FCRPS, and how the deepening of the channel from 0-43 feet further modified sediment inputs into the system.

10.2.4 Near-shore and Plume Study

The Corps should develop and implement a study(ies) examining the potential for impact to near-shore and plume environments produced by ocean disposal of sediments produced by the Project. The areas included in this study(ies) should include all existing and proposed disposal sites at the Mouth of the Columbia River. The study should examine salmonid use of in these areas, (abundance, distribution, food resources, habitat). This study should build upon the current research being conducted by NMFS' Northwest Fisheries Science Center.

a. The study design and plan for ocean disposal of sediments should be submitted to NMFS and the FWS for final approval.

b. The results of the study and the plan for ocean disposal of sediments should be presented to the adaptive management team for consideration during the adaptive management process. The results of this study should be incorporated into future consultations for the navigation channel and the any future reinitiation of consultation activities stemming from the Mouth of the Columbia River maintenance project.

10.2.5 Public Involvement in the Adaptive Management Process

For the adaptive management process to be successful, the process should be a transparent one. The annual adaptive management meetings should be open to the public. During each meeting, there should be an opportunity for questions, comments, and technical input from the public, with response from the adaptive management team. Copies of public comments, data, and information discussed during the meetings should be placed on the Corps' website.

10.2.6 OHSU/OGI ELCIRC Modeling

The OHSU/OGI ELCIRC model analyzed Columbia River estuary habitat opportunity changes between current and future Project conditions. It would be very useful to extend this analysis to riverine portions of the Project area. The Corps should fund the expansion of the ELCIRC model to incorporate the riverine portions of the Project area, and provide those modeling outputs to the adaptive management team for review and consideration.

10.2.7 Pipeline Dredge Disposal

While ESA-listed salmonids mainly use the upper 20 feet of the Columbia River and estuary's water column, these fish may also use deeper portions of the water column for movement and migration. Pipeline dredges, when disposing of materials in or beside the navigation channel, release dredged materials below 20 feet in depth. Fish using water deeper than 20 feet may temporarily encounter a turbidity plume associated with these disposal activities. Where feasible and safe, NMFS recommends that the Corps release pipeline-dredged materials into as deep a depth as possible.

10.2.8 Control of Non-Indigenous Species

NMFS recommends that the Corps continue its efforts to minimize and/or avoid future, non-indigenous species introductions from deep draft vessel traffic associated with the deepened navigation channel by assisting the Coast Guard, and States of Oregon and Washington, in implementing rules to minimize ballast discharge and associated invasive species introductions.

10.2.9 Involvement of the Columbia River Tribes in Project Implementation

The Columbia River Tribes, represented by the Columbia River Intertribal Fish Commission (CRITFC), have specific technical expertise that should be included into the Project implementation. The Corps should encourage CRITFC participation in the following Project activities: Adaptive management process, monitoring program, ecosystem research program, and the annual contaminants review team activities (*see* Table 3.5). The Corps should also encourage CRITFC participation with the Regional Sediment Evaluation Team that is updating the DMEF manual. The Corps should provide funding for CRITFC involvement in these Project and Project-related activities.

11. REINITIATION OF CONSULTATION

Consultation must be reinitiated as follows:

This concludes formal consultation on these actions in accordance with 50 C.F.R. 402.14(b)(1). Reinitiation of consultation is required: (1) If the amount or extent of incidental take is exceeded; (2) if the action is modified in a way that causes an effect on ESA-listed salmonids that was not previously considered in the BA and this Opinion; (3) if through the monitoring and adaptive management process, or by any other means, new information or project monitoring reveals effects on the action that may affect the ESA-listed salmonids in a way not previously considered or in a way not predicted by the 2001 BA or this Opinion; or (4) a new species is listed or critical habitat is re-designated in a manner that may be affected by the action (50 C.F.R. 402.16)

12. INCIDENTAL TAKE STATEMENT

12.1 Introduction

Sections 4(d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm in the definition of "take" in the ESA means an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering (50 C.F.R. 222.102, 2001). Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary. They must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in Section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered in this Incidental Take Statement. If the Corps: (1) Fails to adhere to the terms and conditions of the Incidental Take Statement; and/or (2) fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. The Corps will report to NMFS on annual progress toward implementing these reasonable and prudent measures.

An Incidental Take Statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

This Incidental Take Statement becomes effective at the point of signature of this Opinion, and continues to apply through construction and into the maintenance period of the Project. This Incidental Take Statement will be reviewed every year during the annual meeting of the adaptive management team. As appropriate, NMFS will determine whether reinitiation of consultation is indicated based on new information resulting from the adaptive management process.

12.2 Amount or Extent of the Take

Section 9(a)(1) of the ESA prohibits the taking of ESA-listed species without a specific permit or exemption. Protective regulations adopted pursuant to Section 4(d) extend the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking. 50 C.F.R. 222.102. Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant. 50 C.F.R. 402.02. Section 7(o)(2) exempts any taking that meets the terms and conditions of a written Incidental Take Statement from the taking prohibition.

Take prohibitions of the ESA do not apply to an ESU that is proposed for listing until it is placed on the list of threatened or endangered species at the conclusion of the listing process. Therefore, this Incidental Take Statement will be not effective for any ESU that is proposed for listing during this consultation until that ESU is listed, and the conference portion of this Opinion is confirmed by NMFS as a biological opinion issued through formal consultation.

12.3 Effect of the Take

NMFS expects take to occur because of proposed actions that will harass, harm, injure, or kill individuals of the ESUs considered in this consultation that are likely to be present in the action area during part of the year when some effects of the proposed action will occur. NMFS anticipates that the proposed action covered by this Opinion will result in short-term and long-term incidental take of ESA-listed salmonids.

To the extent practicable, NMFS has defined take in terms of numbers of fish. In the case of take resulting from entrainment and habitat modifications resulting from channel dredging, take caused by these effects cannot be accurately quantified. In such circumstances, NMFS provides a surrogate to quantify the extent of incidental take.

12.3.1 Short-term Extent of Take

Based on BRT discussions of the conceptual ecosystem model, other BRT deliberations including the SEI workshops, and use of the conceptual ecosystem model and numerical models in the effects analysis (*see* section 6 of this Opinion), short-term incidental take of ESA-listed salmonids is reasonable certain to occur.

Blasting. NMFS believes that short-term incidental take, in the form of killing and injury from blasting is reasonably certain to occur during channel construction actions. However, based on the effects analysis in Chapter 6.0 of the 2001 BA, the Corps concluded that few, if any, ESA-listed salmonids are likely to be directly taken as a result of blasting actions. Therefore, NMFS limits the amount of allowable incidental take from the single blasting event to no more than ten adult ESA-listed salmonids and 50 juvenile ESA-listed salmonids. Incidental take occurring beyond these limits is not authorized by this consultation.

Dredging. Dredging activities are reasonably certain to cause short-term incidental take from entrainment. The loss of salmonid prey items due to entrainment and burial in the immediate dredge vicinity may cause short-term take in the form of harm, while localized turbidity at the dredge site may harass ESA-listed salmonids by temporarily modifying their behavior.

Entrainment occurs when organisms are trapped during the uptake of sediments and water by dredging machinery (*e.g.*, clamshell, hydraulic). Cutterhead intake velocities may be as high as 40 feet/second for a 72-inch diameter cutterhead creating a zone of induction. Entrainment would result in the mortality of juvenile salmon, benthic infauna and epibenthic fauna. The probability of juvenile salmonid entrainment is largely dependent upon the likelihood of fish occurring within the dredge prism, dredge depth, fish densities, the entrainment zone (surface area of draghead or cutterhead plus the zone of induction), location of dredging within the river, equipment operations, time of year, and species life stage. Entrainment of adult salmonids, while possible, is considered to be extremely unlikely. Therefore, take of adult salmonids from entrainment is not authorized in this Incidental Take Statement.
Dredging in the action area may occur on a year-round basis. Fish are present in the Lower Columbia River throughout the year. Juvenile salmonids are most likely to occur in the upper 20-25 feet of the water column, although they may use water depths ranging from 22 feet to 37

feet (Carlson *et al.* 2001, Beeman *et al.* 2003). Adult salmonids may use water column depths ranging from 1 to 50 feet, although most adult salmonids are likely to be present in the upper 25 feet of the water column. Dredging in the navigation channel would occur at a minimum dredge depth of 36 feet CRD (this assumes maximum sand wave accretion height), with a maximum dredge depth of 48 feet.

The proposed conservation measure to maintain the cutterheads and dragheads in the sediment or no more than 3 feet above the river bottom is likely to substantially reduce, but not completely eliminate, the potential for fish entrainment. The potential for incidental take from benthic prey entrainment and turbidity is low, and no additional conservation measures have been identified to further reduce the potential for harm and harassment from dredging activities.

Based on the effects analysis in Chapter 6.0 of the 2001 BA, the Corps concluded that few, if any, ESA-listed salmonids are likely to be directly taken as a result of entrainment during dredging. This conclusion was based on dredging techniques required by the Corps and data that indicated that ESA-listed salmonids are not commonly found at the depths being dredged in the navigation channel. The 2001 BA indicates, based on sampling of hopper dredge entrainment events, no ESA-listed salmonids were entrained using hopper dredging methodologies proposed in the 2001 BA.

Based on the behavior of juvenile salmonids in deep-water and shallow water habitats, timing, and the proposed dredging operations and depths, the probability of entraining juvenile salmonids is considered to be low. Applying a methodology[3] that considers the various factors discussed above, NMFS estimates that up to 75 juvenile salmonids may be incidentally taken per year from dredging entrainment in the navigation channel between RM 4.4 and RM 106.4.

Due to the Corps' inability to monitor entrainment events and other potential sources of take associated with dredging activities, the Corps included, as part of the proposed action, to implement and monitor the impact minimization measure of limiting the dredge's draghead and/or cutterhead to be no more than 3 feet above the bottom whenever the dredge pumps are running (Table 3-2 of the 2001 BA). The Corps will not exceed the level of estimated take through controlling the operation of the draghead and/or cutterhead to a depth level of -35 feet CRD off the river bottom while the pumps are running (not idling).

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[3] An estimate of the amount of incidental take associated from entrainment was generated by first calculating the percent area of the navigation channel to be dredged in a given year relative to the total navigation channel area. The total navigation channel area was then multiplied by the average channel depth to calculate a relative volume. The 4-year smolt average (NWFSC 2004) was then divided into the relative cross-sectional volume to generate a fish density. A volumetric dredge cell was estimated to calculate a fish density relative to a given dredge cell within the cross section. After factoring minimum dredge elevations, equipment operations, and dredge intake velocities, a percent of the water column relative to the entrainment zone and fish use potential was calculated to estimate a number of fish in the entrainment zone. Relative fish abundance to peak outmigration and non-peak rearing and outmigration was then calculated over a 12 month period to estimate the number of fish subject to entrainment relative to season. This number was then divided by the number of likely hours that dredging actually occurs per year. This number was then multiplied by a residence time coefficient and then multiplied by an error coefficient calculated from the total estimate of juvenile salmonid abundance evenly distributed in the lower Columbia River.

NMFS believes that the Corps reporting the draghead location while the pumps are running (not idling) to be an adequate surrogate of direct take resulting from entrainment during dredging. If the draghead and/or cutterhead is higher than -35 feet CRD or more than 3 feet off the river bottom while the pumps are running (not idling) for more than 3 times in a 8 hour period, the Corps must stop dredging operations and reinitiate consultation with NMFS.

NMFS expects some low level of incidental take of ESA-listed salmonids to occur in the form of harm as a result of the loss of salmonid prey items due to entrainment and burial in the immediate dredge vicinity and in the form of harassment from localized turbidity at the dredge site that may temporarily modify fish behavior. However, the best scientific and commercial data available are not sufficient to enable us to quantify the amount of take reasonably certain to occur as a result of these aspects of dredging activity. Therefore, NMFS utilizes the total volume of dredged material as a reasonable surrogate indicator to represent the extent of incidental take from these dredging effects. Monitoring action MA-2, included in this Opinion, focuses on monitoring annual dredging volumes to determine if they exceed those proposed in the Project. Data generated during pre-construction, construction, and post-construction phases of the Project will be used to determine if changes in Project are necessary. Such determinations will be made through the adaptive environmental management process for the Project (*i.e.*, mitigation actions, project modification, stop project - *see* Figure 2.3 in Bartell 2004). Should the monitoring of dredged material volumes and subsequent evaluation through the adaptive management process reveal effects that exceed those predicted, the Corps would be required to reinitiate consultation with NMFS.

<u>Ecosystem Restoration Features</u>. In the 2002 Opinion, NMFS was unable to quantify the level of expected short-term take resulting from the construction of ecological restoration measures because of uncertainties related to the construction of the Millar-Pillar and Lois Mott ecological restoration measures. However, these two restoration measures have been eliminated from the proposed action as a result of Oregon's Coastal Zone consistency determination and are no longer covered by this Incidental Take Statement

Since the release of the 2002 Opinion, NMFS has been working with the Corps on the implementation of the remaining ecosystem restoration features. Base on new information provide by the Corps, NMFS can now provide more detailed information concerning restoration construction and the likely short-term take from the remaining restoration actions.

The estimated take is as follows:

Purple Loosestrife Control Program:
    Projected Take - No take is anticipated because the Corps is employing a biological control agent for this program that does not adversely affect ESA-listed salmonids.

Tenasillahe Island Interim Restoration:
    Projected Take - 0 adults, 36 juveniles

Tenasillahe Long-term:
    Projected Take - To be determined during site specific ESA consultation

Bachelor Slough:
Projected Take - 0 adults, 20 juveniles

Tidebox Retrofits:
Projected Take - 2 adults, 66 juveniles

Lord-Walker Hump-Fisher Improved Embayment Circulation:
Projected Take - No take occurred because project construction occurred in the dry.

These estimates of the amount of incidental take are based on the expected densities of ESA-listed salmonids within the action area and the proposed restoration construction activities as described in section 6.7.2 of this Opinion. Note that this habitat to be affected by this Project is not unique to the Lower Columbia River, nor will the effects thereto substantially affect population abundance, growth rate, spatial structure, or diversity of each ESU addressed in the Opinion.

12.3.2 Long-term Extent of Take

Over the long term, Project-related habitat modifications to the Lower Columbia River, estuary and river mouth may degrade shallow water habitat important ESA-listed salmonids, and therefore cause harm to these species.

Habitat Modifications Resulting from Channel Dredging. Habitat modifications resulting from channel dredging are likely to occur throughout the Project area. Habitat impacts from dredging and disposal sites are addressed in Sections 3.3.2 - 3.3.9 of the 2001 BA.

Upland Disposal. As identified in section 6 of this Opinion, changes in the volume of dredged material disposed of at upland sites may affect habitat forming processes such as sediment accretion and erosion in the vicinity of the disposal sites. Localized effects to these habitat processes in turn, may affect the amount and quality of shallow water habitats (*e.g.*, tidal marsh and swamp) which provide important foraging and rearing (*i.e.*, feeding habitat opportunity, refugia, and habitat-specific food availability) areas for ESA-listed juvenile salmonids.

According to the Corps, upland dredged material disposal sites proposed by the Corps have been sited on existing disposal sites of low habitat value or occur behind main flood control levees where ESA-listed salmonids are virtually excluded from access and export of detritus and terrestrial insects is limited. Additionally, large woody debris is scarce in these areas. NMFS believes that effects from the deposition of dredged material at upland disposal sites, although limited in nature, are reasonably certain to result in a low level of incidental take of individuals.

While NMFS expects some low level of incidental take to occur, the best scientific and commercial data available are not sufficient to enable us to quantify the amount of take reasonably certain to occur as a result of this activity. Therefore, NMFS utilizes the volume of dredged material disposed at these upland sites as a reasonable surrogate to measure the extent of incidental take.

The Corps developed an updated disposal plan based on the Final supplemental EIS prepared in 2002 (Final Supplement EIS [2003] Table S4-1. Proposed Disposal Plan Including Beneficial Use Sites, Ecosystem Restoration and Wildlife Mitigation [Martin Island Embayment]). Monitoring action MA-2, included in this Opinion, focuses on monitoring annual dredging volumes to determine if dredge disposal volumes exceed those proposed in the Project. Data generated during pre-construction, construction, and post-construction phases of the Project will be used to determine if changes in Project are necessary. Such determinations will be made through the adaptive environmental management process for the Project (*i.e.*, mitigation actions, project modification, stop project - *see* Figure 2.3 in Bartell 2004). Should the monitoring of dredged material volumes reveal that the material being deposited into the sites is not what was predicted (*see* Table S4-1, referenced above), the Corps would be required to reinitiate consultation with NMFS.

Estuary-wide Habitat Impacts. The analysis in section 6.2.2 of this Opinion discusses how habitat forming processes that result in the natural development of tidal marsh and swamp habitats in estuary areas like Cathlamet and Grays Bays could potentially be affected in the long term by the Project. Based on the risk and uncertainty analysis conducted by the BRT (*see* Table 7-1 of the 2001 BA), how these impacts could affect ESA-listed salmonids and their habitats is uncertain over the life span of the Project. Although these potential long-term effects to ecosystem indicators are not of high risk to ESA-listed salmonids or their critical habitat at the ESU level, NMFS believes implementation of the Project is reasonably certain to result in a low level of incidental take (harm) of individuals.

While NMFS expects some low level of long-term incidental take to occur, the best scientific and commercial data available are not sufficient to enable us to quantify the amount of long-term incidental take that is reasonably certain to occur over the life of the Project. Therefore, NMFS utilizes bathymetric changes induced by the Project as a reasonable surrogate to measure the extent of incidental take.

Bathymetry was chosen as a surrogate because changes in this physical indicator can affect tidal marsh and swamp habitats for juvenile salmonids. Tidal marsh and swamp habitats are particularly important to juvenile salmonids because they provide feeding habitat opportunity, refugia, and habitat-specific food availability. These habitat types are generally defined by specific elevation ranges (2001 BA, Figure 5-5). Therefore, measuring changes in bathymetry is important because ocean-type juvenile salmonids use the edges of these marshes to feed, and the edges of shallow channels within the marshes as refugia and feeding areas (2001 BA, Figure 5-6). The aquatic edge is considered to be an important factor governing the exchange of organisms and the connectivity associated with the channels offers more opportunity to marsh access (Shafer and Yozzo, 1998). Consequently, access to the edges at high tide and development of low-tide refuge areas near or within marshes is critical to lower river ocean-type juvenile salmonids. Channel order (the number and width of channels) and channel depth are also functional characteristics of a marsh area. A change in bathymetry could affect the quality and quantity of this habitat.

Therefore, NMFS has determined that the post-construction measurement of changes in bathymetry is an appropriate surrogate for long-term take. The Corps completed a bank-to-bank bathymetric survey of the estuary (mouth to RM 40) in 2004. This data will compliment the 1984

CREDDP data to show natural changes that occurred in the estuary over a twenty-year period. As require by the State of Washington's 401 water quality certification, the Corps will repeat the bank-to-bank survey from RM 3 to 18 within two years after completion of construction. Although the potential long-term effects to ecosystem indicators are not of high risk to ESA-listed salmonids at the ESU level (*see* Table 7-1 of the 2001 BA), NMFS believes the effects are reasonably certain to result in harm to individuals of the ESA-listed species, consequently resulting in a low level of incidental take.

To address the long-term change to habitat types in the estuary the Corps will repeat the bank-to-bank estuary survey (mouth to RM 40) five years after the State of Washington's required survey and compare the results to the previous surveys of the estuary. This portion of the river (*e.g.*, Cathlamet Bay, Grays Bay) was chosen because the habitat is important to ESA-listed juvenile salmonids. If this comparison demonstrates that the Project caused an appreciable reduction in the type, value, or function of either tidal marsh and swamp habitats or shallow-water and flats habitats, the Corps will reinitiate consultation with NMFS. However, in any circumstance, reinitiation shall be required if a 1% or greater reduction in acreage occurs.

12.4 Reasonable and Prudent Measures

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of ESA-listed salmonids from activities associated with navigation channel improvements:

1. Minimize the likelihood of incidental take associated with short-term (direct and indirect) impacts to listed salmonids during Project construction and maintenance activities.

2. Minimize the likelihood of incidental take associated with long-term uncertainty and associated risk regarding Project effects by implementing a monitoring program.

3. Minimize the likelihood of incidental take associated with project impacts by implementing an adaptive management process to review results of monitoring program and other applicable new information, and determine actions necessary to minimize any adverse effects.

4. Minimize the likelihood of incidental take during implementation of ecosystem restoration features that aid in the recovery of ESA-listed species in the Lower Columbia River, estuary and river mouth.

5. Provide NMFS with annual reports from Project compliance, monitoring, restoration, and research activities to ensure adequate organization, coordination, and reporting of all information resulting from the Project and this Opinion.

12.5 Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. In order to minimize the likelihood of incidental take associated with short-term (direct and indirect) impacts to ESA-listed salmonids during Project construction and maintenance activities, the Corps shall do the following:

    a. Minimize effects from entrainment through the following actions:
        i. Implement the dredging Impact Minimization Measures and Best Management Practices as identified in Chapter 3 of the 2001 BA.
        ii. Monitor operation of the dredge draghead and/or cutterhead to minimize the time they are removed from the substrate.
    b. Minimize effects from blasting through the following actions:
        i. The blasting plan, outlined on page 6-20 of the FEIS for the Project, will be developed in conjunction with Federal and state agencies and submitted to NMFS for approval 30 days before blasting. The blasting plan will include specific monitoring actions to determine if any listed fish are killed or injured, and include a clause that, if the blasting results in a take of listed salmonids, the Corps will discontinue blasting until such time as that take can be assessed and measures enacted to minimize impacts.
        ii. The results of the blasting plan monitoring shall be presented at the adaptive management team meeting during the year in which the blasting occurs.
    c. Before navigation channel construction and maintenance implementation, the Corps shall provide a "contractor compliance plan" to NMFS for review and approval. The plan must describe specific compliance monitoring actions, designed to minimize impacts to ESA-listed salmonids, that will occur during dredging and disposal actions, as described in 2001 BA table 7-4, 7-5, and 7-6. In addition, the contractor shall be required to report to the Corps any unanticipated or unusual events or visual observations (*e.g.*, water surface oil slicks, injured/dead fish, unusual colored or smelling sediments) that are not required in the contractor compliance plan. If take of ESA-listed species is observed during compliance monitoring, the NMFS shall be contacted immediately to determine the need for Project modification, mitigation, or cessation.

2. In order to minimize the likelihood of incidental take associated with uncertainty and risk regarding long-term Project effects, the Corps shall implement a monitoring program with the following elements:

    a. The Corps shall finalize and implement the monitoring program (Table 7-3 of the 2001 BA). All activities related to scope identification, *i.e.*, goals, milestones for completion, and check-in points, triggers for management change (management decision points that include specific metrics), and sampling/testing protocols to be developed, will be coordinated with NMFS. The final monitoring program shall also ensure that adequate pre-, during, and post- construction monitoring actions occur to allow for comparable pre- and post-Project data analysis.
    b. Two proposed monitoring actions, MA-1 and MA-3, shall be implemented over a longer time-scale (Term and Condition 5.a.1 of this Incidental Take Statement discusses Adaptive Management timeframes that link to long-term monitoring actions) than proposed in the 2001 BA. These monitoring activities are vital to

understanding long-term Project-related changes to the Lower Columbia River, estuary and river mouth, and to allow for future adaptive management team decisions. Therefore, the Corps will continue, for the entire duration that the adaptive management program is operating, to collect and analyze data associated with MA-1 and MA-3 activities.

c. Through monitoring measure MA-4, the Corps shall ascertain Project related changes in habitat. Additionally, the Corps shall compare results of this monitoring action to any similar research efforts by the Northwest Fisheries Science Center's (*i.e.*, their Columbia River estuary study) or other organizations in the estuary for a more complete assessment of habitat changes. At the end of the proposed monitoring period, monitoring results from MA-4 and associated research/monitoring shall be reviewed by the adaptive management team. The adaptive management team will determine whether additional MA-4 actions or a sub-component of MA-4 will go forward into the future.

d. In developing the above monitoring program information, the Corps will use the scope and sampling/testing protocols being implemented by the Northwest Fisheries Science Center in their on-going research activities in the Lower Columbia River and estuary as the basis for design. The final program will also describe how the various actions integrate together to form an ecosystem approach to evaluating ecosystem changes overtime.
    i. Since the issuance of the 2002 Opinion, the final monitoring plan was submitted to NMFS in March 2004.
    ii. Implement the final monitoring program, as per the implementation dates.
    iii. Ensure that development and implementation of the monitoring program is consistent with the 2004 FCRPS Hydropower Biological Opinion.

e. The Corps shall continue to work with NMFS and FWS on the revision of the DMEF manual to develop a set of contaminant testing protocols appropriate for marine and fresh water environments. Upon final completion of the revised DMEF manual, the monitoring program will be updated based on the new manual based on the contaminants portion of the monitoring program (*see* Table 7-3 of the 2001 BA, item MA-5). These changes may require additional changes to the monitoring program. Any changes are deemed necessary, will be submitted to NMFS for review and approval before their implementation. The Corps shall continue to support the work of the Regional Sediment Evaluation Team that is updating the DMEF manual.

f. The best available information indicates that the Columbia River navigation channel sediments do not exceed current DMEF or NMFS contaminants thresholds. The interagency contaminants review team, identified in MA-5, shall ensure that the Project continues to proceed with the best available sediment and contaminant information. The interagency contaminants review team shall meet annually to review sampling distribution and frequency, sediment quality, and contaminants concerns of all Lower Columbia River, estuary and river mouth sediment sample locations. The interagency contaminants review team shall provide the adaptive management team with annual, or more regular, updates on current sediment and contaminants information in the Project area.

Since the issuance of the 2002 Opinion, the interagency contaminants review team has continued to work with the adaptive management team to identify if additional sampling or contaminants testing necessary for purposes of minimizing contaminants re-suspension from Project dredging and/or disposal activities. The Corps shall complete additional sediment and contaminant samples determined necessary by the adaptive management team. Any samples that the adaptive management team determines are necessary as a result of the January 2003, meeting shall be completed before Project construction.

g. The Corps shall host an ETM workshop to better understand and propose meaningful management actions to conserve the ETM. The ETM workshop will be held in October 2005. The Corps will coordinate the following actions with NMFS in the development of this workshop, including:
   i. Develop the scope of the meeting, agenda, and list of meeting attendees.
   ii. Make information obtained through monitoring and research available for the workshop.
   iii. Prepare a final report of the ETM workshop to be submitted to NMFS one month after completion of the workshop.
   iv. Present the results of the ETM workshop (final report) to the adaptive management team.
   v. Present management actions from the final ETM report to the adaptive management team for consideration in the adaptive management process.

h. The Corps shall minimize effects from stranding through the following actions:
   i. Develop and implement a stranding study to be developed in conjunction with NMFS, FWS, the Ports, and appropriate state agencies. The stranding study will evaluate parameters that influence stranding. Potential factors include: cross-sectional area, velocity, water level, bank configuration, location along river, slope of bank, ship traffic past site, and type, size, draft, and speed of vessel. To the extent appropriate, the Corps will integrate this study with efforts related to implementation of the September 15, 1999 Opinion on the operation and maintenance dredging from John Day Dam to the Mouth of the Columbia.
   ii. The scope of the stranding plan shall include an identified scope including goals, milestones for completion, check-in points, triggers for management change (*i.e*, management decision points that include specific metrics), and sampling/testing protocols to be developed in coordination with NMFS.
   iii. The results of the stranding plan shall be used to develop a plan to minimize and/or eliminate fish stranding. The stranding minimization plan, as it applies to ship traffic will be provided to the U.S. Coast Guard, for use in their regulation of river traffic, and to the adaptive management team for consideration during the adaptive management process.
   iv. Since the issuance of the 2002 Opinion, the stranding study design was submitted to NMFS in June 2004 for approval.
   v. Since the issuance of the 2002 Opinion, the stranding study, which was originally to be implemented in April 2003, was approved by NMFS in June 2004, and is now being implemented.
   vi. The results of the stranding study, including management recommendations to minimize stranding, shall be presented at the adaptive management team

meeting (January 2006). Management recommendations shall be reviewed by the adaptive management team and implemented where feasible.

vii. The stranding study will be repeated two years following construction of the deeper channel.

viii. Post-construction stranding studies will be evaluated by the adaptive management team.

i. In the event the Project will use ocean disposal at the Deep Water Site (*see* Section 3.2.8 of the 2001 BA), the management plan for this disposal site will be coordinated with NMFS.

3. The Corps shall implement an adaptive management process to review results of the monitoring program and other applicable new information and determine actions necessary to minimize any adverse Project effect.

a. Establish the adaptive management team that implements the adaptive management process. The adaptive management team will meet annually (or more frequently if new circumstances arise) to review scientific information collected through monitoring, research, or BMPs while implementing this action.

b. The adaptive management team shall assess Project effects, and evaluate the effectiveness of the compliance measures, the monitoring program, research, and ecosystem restoration features. In doing so, the adaptive management team will ensure that Project construction, operation and maintenance, and ecosystem restoration features have no greater impacts than predicted in the 2001 BA or in this Opinion and Incidental Take Statement.

c. If an adverse effect is determined by the adaptive management team, the Corps shall, within 30 days, submit an impact minimization plan to NMFS for approval. The Corps plan could range from proposing mitigation actions, to modifying or stopping the Project if warranted.

d. The Corps will work cooperatively with NMFS and FWS to develop goals, stated purposes, operating principles, and composition of the adaptive management team. The Corps should review 65 FR 35242 for overview of using adaptive management for certain ESA-listed species decision-making and permitting activities. Portions of this policy document may be pertinent to the Corps' final design of the adaptive management process for this Project. The framework for actions taken by the adaptive management team shall be based on the following:

i. <u>Short-term</u> (Years 0-5: Pre-construction, construction, and post-construction). Focus shall be on potential short-term project impacts and modifications to minimize impacts. The effectiveness of the compliance measures, the monitoring program, research, and ecosystem restoration features will be evaluated. Additional mitigation features may be recommended for implementation and/or modifying or stopping the project if warranted.

ii. <u>Mid-term</u> (Years 5-10). Conduct trend analyses with monitoring data and research actions to detect ecosystem changes over the longer term and apply to actions identified above.

iii. Long-term (Years 10 and beyond). Translate trend analysis information into long-term trends in ecosystem impacts and restoration of the ecosystem.

e. Information gathered through monitoring and research actions will be used to annually assess Project effects to the following indicators:[4]
   i. Shift in the location of the ETM.
   ii. ETM functions.
   iii. Accretion/erosion rates.
   iv. Habitat types.
   v. Food resources for salmonids.
   vi. Changes to sideslope adjustments beside the entire navigation channel and associated loss of shallow water/flats or tidal marsh and swamp habitats in riverine and estuarine areas.
   vii. Physical features of habitat types, habitat opportunity, bathymetry, bedload changes, rate of suspended sediment transport, and water level changes to the estuary.
   viii. Structure, distribution, net productivity, and detritus production of marshes and swamps.
   ix. Velocity changes in shallow water habitats and available refugia.
   x. Salinity changes as they impact habitat types.

f. Since the issuance of the 2002 Opinion, the Corps submitted the final design of the adaptive management process to NMFS in December 2002 for approval.

g. Since the issuance of the 2002 Opinion, the Corps conducted the first adaptive management team meeting in January 2003. The adaptive management team will function for the duration of the monitoring program and prescribed ecosystem research actions. The Corps will provide facilitation support at all meetings of the adaptive management team.

h. The Corps shall ensure that development and implementation of the adaptive management process is consistent with the estuary sections of the 2004 FCRPS Hydropower Biological Opinion.

4. In order to minimize the likelihood of incidental take through implementation of ecosystem restoration features (*see* Table 8-2 of the 2001 BA), the Corps shall:

   a. Conduct all shallow water ecosystem restoration in-water construction activities, including excavation and dredge material placement, during approved in-water construction windows. The pipeline dredge in-water construction window for ecosystem restoration projects in the Lower Columbia River and estuary is November 1 to February 28. Hopper dredge disposal in deep water temporary storage sump locations, does not have an in-water construction window. The in-water construction window for Columbia River tidegate retrofit projects is July 1 to September 15.

[4] These are minimum effects to be examined based on the state of knowledge at the time this Opinion was issued. As additional effects are identified, or the existing list of effects is modified, this list will be changed to fit the contemporary needs to the monitoring program and adaptive management process.

b. To the extent practicable, maintain dredge draghead and/or cutterhead at or below the substrate surface during ecosystem restoration construction activities that require dredging activities.

c. Tidegate retrofits:

   i. The Corps shall enter into an agreement with the Project sponsors that will require the sponsors to ensure future maintenance of retrofitted tidegates. In addition, the Corps will require guarantees from the Project sponsors that volitional fish passage, via timely operation of the tidegate passage features, will occur during key salmonid migration periods. The Corps will coordinate fish design for tidegate retrofits with NMFS fish passage engineers.

   ii. The Corps shall coordinate fish passage designs for tidegate retrofits with NMFS fish passage engineers.

e. The Corps shall coordinate with NMFS on the development and implementation of pre- and post- monitoring protocols for the ecosystem restoration features to gauge their effectiveness in restoring the type, function, and value habitats identified in the 2001 BA. The Corps' restoration features monitoring plans shall be submitted to NMFS for review and approval by December 15, 2005.

5. The Corps shall provide NMFS with annual reports starting one year after the date of this Opinion regarding Project compliance, monitoring, restoration, and research activities. The report shall also summarize annual implementation of reasonable and prudent measures and their implementing terms and conditions.

   a. Compliance:

      i. The Corps will submit a series of reports based on the dredging Impact Minimization Measures and BMPs for compliance (*i.e*., construction and maintenance) actions to NMFS in six-month intervals during the construction process. These reports shall include the following minimum elements: a description of how the Corps implemented and responded to the impact minimization measures and BMPs, how much material was dredged and disposed of, how many fish were taken due to blasting, were any unusual sediments encountered and how were these events addressed, how effective were the BMPs in minimizing impacts from Project construction, and how the Corps addressed any adverse compliance monitoring finding.

      ii. The Corps must record daily operations while dredging to ensure all BMPs are followed. In order to complete this task, the Corps will develop a standard tracking table for workers of the dredging vessels. The results of the tracking information will be included in summary form and as an appendix to the construction and maintenance annual reports (*see* Integrated Annual Report requirement, below).

   b. Monitoring Activities:

      i. An annual monitoring report will be completed for each monitoring action (MA-1 to MA-6). The following shall be included in the monitoring report for each monitoring action: (1) Overview of monitoring action; (2) monitoring data and results; (3) description of adverse impacts to ESA-listed salmonids and/or their habitats that were determined to be related to Project activities; and (4) recommendations to be reviewed by adaptive management team.

c. Ecosystem Restoration Features:

i. Upon completion of each restoration feature, the Corps will submit an monitoring report to NMFS. The report will include:

(1) Detailed discussion of monitoring results.

(2) Photographic documentation of environmental conditions at the project site before, during, and after project completion.

(3) Photographs will include general project location views and close-ups showing details of the project area and project, including pre and post construction.

(4) Each photograph will be labeled with the date, time, photo point, project name, the name of the photographer, and a comment describing the photograph's subject.

(5) Recommendations on methods to improve site-specific restoration feature.

d. Ecosystem Research Actions:

i. An annual research progress report, and a final report, shall be completed for each research action. Each final report shall clearly define research objectives, and report on research findings. Recommendations for additional research, or discussion of management implications, also shall be provided.

e. Integrated Annual Report:

i. The Corps shall provide an annual progress report that documents the Corps progress implementing all reasonable and prudent measures and their implementing terms and conditions. As appropriate, based on the Integrated Annual Report, NMFS will determine whether reinitiation of consultation is indicated.

If a dead, injured, or sick endangered or threatened species specimen is found during Project dredging, disposal, monitoring, research, or restoration feature, initial notification must be made to the National Marine Fisheries Service Law Enforcement Office, at the Vancouver Field Office, 600 Maritime, Suite 130, Vancouver, Washington 98661; phone: 360.418.4246.

Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed.

13. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirements of Section 305(b) MSA directs Federal agencies to consult with NMFS on all actions, or proposed actions, that may adversely affect EFH. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council identified EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document. The proposed action and action area are detailed above in section 3.2 of this Opinion. The action area includes habitats that have been designated as EFH for various life-history stages of Chinook and coho salmon.

13.1 EFH Related to the Project

Upon withdrawal of the December 16, 1999, Opinion, NMFS also withdrew its EFH analysis for groundfish and coastal pelagic species. At that time, there was not a finalized salmon EFH appendix to the *Pacific Coast Salmon Plan* that could be included in the 1999 Opinion. Now that a final EFH appendix exists, this Opinion includes an EFH analysis and determination of potential adverse effects to Chinook and coho salmon (*see* sections 6. and 13.6 of this Opinion).

The Corps did not include their existing EFH response for groundfish and coastal pelagic species in their 2001 BA. Therefore, NMFS has requested, and the Corps has agreed, to address EFH for groundfish and coastal pelagic species as part of their upcoming supplemental EIS process for the Project. NMFS will review the information provided in the supplemental EIS as well as our previous correspondence with the Corps on this subject and provide a new determination at that time.

13.2 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. While NMFS understands that the proposed dredging and disposal Impact Minimization Measures and BMPs identified in Chapter 3 of the 2001 BA will be implemented by the Corps, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. However, the Conservation Measures outlined in section 10 of this Opinion and all the Reasonable and Prudent Measures and Terms and Conditions outlined in section 12 of this Opinion are generally applicable to designated EFH for Chinook and coho salmon and address these adverse effects.

13.3. Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations (50 C.F.R. 600.920(j)(1)). The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects that the activity has on EFH. If the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

13.4 Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 C.F.R. 600.920(k)).

14. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) ('Data Quality Act') specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: This document records the results of an interagency consultation. The information presented in this document is useful to three agencies of the Federal government (NMFS, the Corps, and FWS), the sponsoring Ports (Portland and St. Helens, in Oregon, and Vancouver, Kalama, Longview and Woodland in Washington), and the general public. The information is useful and of interest to the general public as it describes the manner in which public trust resources are being managed and conserved. This consultation also fulfills multiple legal obligations of the named agencies and sponsoring Ports. The information presented in this Opinion and used to prepare it represents the best available scientific and commercial information and has been improved through interaction with the Corps.

Individual copies were provided to the Federal agencies. The Corps will provide a copy of the Opinion to the sponsoring Ports. This consultation will be posted on the NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 C.F.R. 402.01 *et seq*., and the MSA implementing regulations regarding EFH, 50 C.F.R. 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

15. REFERENCES

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